ANALYSIS OF THE SINGLE-COLOR OFFSET PRESSMAN'S TRADE

WITH SUGGESTED COURSE OF STUDY

BY

DAVID J. MACDONALD

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY, IN THE FACULTY OF PHILOSOPHY, AT COLUMBIA UNIVERSITY

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FOREWORD

Investigations of this character may prove valuable either because of the specific results obtained or because of the techniques employed in securing and verifying such results. In this instance, it is believed that the investigation will prove of value for both of these reasons. For the first, because of the possibility of developing basic texts from the results, as indicated in the sample instructional material; and for the second, because of the possible application of the techniques employed to other fields of research.

The chief merit of this study is found in the techniques used for securing and verifying the trade and technical data. No claim to originality is made with regard to these techniques. In no sense are they new; they are merely used in new ways and for new purposes. It is primarily because of this successful adaptation of techniques that the study should prove of value to others, more especially to those interested in securing reliable content for developing either vocational training courses or basic text material. There is no apparent reason why the techniques employed here could not be employed with equal success in analyzing other trades for similar purposes. Whether or not they possess universal application remains to be seen.

I wish to express my gratitude to Professor David Snedden for his stimulating suggestions while the study was in its initial stages, and to Professor Harry D. Kitson both for encouragement and for helpful criticisms as it neared completion. I wish also to express appreciation to Professors Frederick G. Bonser and George D. Strayer.

To L. S. Hawkins, managing director of the Lithographic Technical Foundation, I am indebted not only for the suggested field of study and the topic for investigation but also for substantial encouragement and helpful criticisms while the work was in progress. I am glad also to record my appreciation of the expert assistance so cheerfully given by F. S. Garcia, pressroom foreman for The Sackett & Wilhelms Corporation. This list of acknowl-

edgments would be incomplete if the name of Adolph Greenstein, offset pressman for the W. F. Powers Company, were not included. His assistance was especially valuable in connection with the suggested course of study.

Finally, I desire to thank the Lithographic Technical Foundation for the opportunity to make the investigation; and the numerous executives and pressroom employees in the various lithographing plants for their willing and able coöperation. A partial list of these follows: Ault & Wiborg Co., New York, N. Y.; Brett Lithographing Co., Long Island City, N. Y.; Columbia Planograph Co., Washington, D. C.; Edwards & Deutsch Litho. Co., Chicago, Ill.; Forbes Lithograph Mfg. Co., Boston, Mass.; Fuchs & Lang Mfg. Co., New York, N. Y.; Goes Lithographing Co., Chicago, Ill.; Harris-Seybold-Potter Co., Cleveland, Ohio; Heywood Co., Inc., R. R., New York, N. Y.; Ketterlinus Lithographic Mfg. Co., Philadelphia, Pa.; Latham Lithographic & Printing Co., Long Island City, N. Y.; Miehle Printing Press & Mfg. Co., Chicago, Ill.; Niagara Lithograph Co., Buffalo, N. Y.; Powers, W. F. Co., New York, N. Y.; Rochester Folding Box Co., Rochester, N. Y.; Sackett & Wilhelms Corp., Brooklyn, N. Y.; Schmidt Lithograph Co., San Francisco, Cal.; Sinclair & Valentine Co., New York, N. Y.; Stecher Litho. Co., Rochester, N. Y.; Traung Label & Litho. Co., San Francisco, Cal.; Trautman, Bailey & Blampey, New York, N. Y.; U. S. Printing & Lithograph Co., Brooklyn, N. Y.

David J. MacDonald.

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PART I

ANALYSIS OF THE OFFSET PRESSMAN'S TRADE

CHAPTER I

INTRODUCTION AND STATEMENT OF PROBLEM

Introduction

Lithography or lithographic printing, as it is commonly called, has been carried on since 1817. Offset lithography, however, particularly on rotary presses, the phase of the industry with which this study is concerned, is a comparatively recent development.[1] Due in part to this fact, in part to the phenomenal progress which has marked the growth of this industry during the last decade, and in part to the failure to provide adequate training facilities, a dearth of competent offset pressmen has gradually developed. Notwithstanding the realization on the part of a few of the leaders in the industry of the need for constructive action, nothing was done by the industry as a whole to relieve matters. In fact, as late as 1925 when this investigation was begun, only two classes for training apprentices to become offset pressmen could be found in the entire country. In a word, the "pick-up" method for securing the necessary trade training had prevailed exclusively up to that time, except in a few of the larger plants where arrangements for overcoming the growing shortage by training apprentices have obtained for several years, but especially during and since the 1922 strike.[2]

[1] Offset lithography dates back as far as 1875, when the first flat bed offset press was set up and operated. But rotary offset presses, to which much of the remarkable development in the industry is due, were first used in the United States in 1905. The following figures, though only approximate in character, show clearly enough the rate at which developments have taken place.

Table of New Offset Presses Placed in Lithographing Plants

Year	Number of Presses	Year	Number of Presses
In 1921	80–100	In 1924	160–180
In 1922	100–120	In 1925	180–200
In 1923	135–150	In 1926	240–260

[2] The exact nature of this shortage is not known. One way of determining the approximate amount of such shortage is to note the number of offset presses placed in lithographic

It was to correct this undesirable condition that the Lithographic Technical Foundation, Inc., was established in 1923. The stated objectives of this organization, as set forth in its certificate of incorporation, are:

1. The promotion and encouragement of the training and education of lithographic workmen.
2. The promotion and maintenance of lithographic trade schools.
3. The investigation, research, and discovery of subjects, principles, laws, and processes of scientific or technical character which relate to lithographic processes.
4. The application of such knowledge to the improvement of those interested in the lithographic trade.

Statement of Problem

As stated in the Introduction, one of the purposes for incorporating the Lithographic Technical Foundation was that the training and education of lithographic workmen might be promoted and encouraged. Necessarily, the realization of such a purpose depends to a large degree upon the soundness of the educational program and the method of carrying this program through. But since no educational program can be a success without suitable instructional material, and since this type of material had not been made available for any lithographic trade, the Foundation's first problem was to prepare such material.

A survey of the industry revealed a pressing need for offset pressmen. Accordingly, the decision was made to give first attention to the preparation of instructional material for offset pressmen apprentices. And, since it is now universally recognized that satisfactory instructional material for any specific trade must be based upon an accurate analysis of that trade, the first

plants during the last few years and to compare this information with the number of apprentices in the same plants. It is to this end that the following data are given.

With regard to the number of apprentices in the industry between 1921 and 1926 authentic information is lacking. It is probably safe to say that in 1926 the number of apprentices in the entire industry was between 250 and 300; and that the number of journeymen pressmen (offset) approximates 2,000. The following estimate is based upon the assumption that the average working life of the offset pressman is 25 years.

1. Estimated number of offset pressmen who are journeymen	2,000
2. Estimated years of service of journeymen	25
3. Estimated number of pressmen needed each year to counteract unavoidable loss	80
4. Estimated number of new pressmen needed annually for new presses only	170
5. Estimated (total) number of new offset pressmen needed annually by the industry so long as it continues the rate of development maintained from 1921–1926	250
6. Estimated number of offset press apprentices now in industry	300
7. Estimated number of offset pressmen annually entering the industry by the apprentice route (300 ÷ 4 = period of apprenticeship)	75
8. Estimated annual shortage of offset pressmen to the industry because of inadequacy of apprenticeship provisions (250 − 75)	175

task of the Foundation was to analyze the offset pressmen's trade. It was to the performance of this task that the writer turned his attention, and it is with the technique employed in making the analysis, the results attained, and the verification of the same that this treatise is primarily concerned. It concerns itself, also, though in a secondary capacity, with the practical uses made of the completed analysis, and, to that end, diagnoses the educational needs of offset pressmen apprentices and prescribes what is believed to be a sound course of study. Finally, it shows the practical way in which this analysis is being used as the basis for instructional material.

The next chapter is devoted to a description of the various techniques used when making the analysis.

CHAPTER II

TECHNIQUE EMPLOYED IN MAKING THIS ANALYSIS

For making each type of analysis, there is presumably a best method or technique to follow. What this method is, will be, or should be for any single trade is rarely ever known in detail, it is safe to say, at the time of starting the analysis. This is due in part to the analyst's ignorance of the various possible techniques that might be used; but it is doubtless also due to the fact that a suitable technique cannot be selected or devised, as the case may be, until the field to be analyzed is critically studied. The present study furnishes an excellent illustration of this, in that many of the details of technique eventually used were not even anticipated when the analysis was started.

No claims are made for originality with regard to the techniques used in this study. They are merely adaptations of age-old techniques to new situations. So far as the writer is aware, however, no one has ever before employed them to the same ends. To illustrate: The observation-question method of determining the teachable content of a trade had never been used exclusively heretofore or, if so, had not been reported as such.[1] This, moreover, is believed to be the first time that the so-called "defect" method of approach was ever employed for discovering trade content.

The field of analysis was found to consist of four distinct phases, or divisions; consequently, the use of four more or less distinct techniques was necessary. These phases are: (1) offset press operations, (2) lithographing defects with their respective causes and remedies, (3) offset inks and the ingredients (reducers and driers) used when mixing such inks, and (4) operations connected with "making the run." [2]

Details of the technique employed in each instance are given below.

[1] One form of this method was employed by L. S. Hawkins when he analyzed the tile setter's trade before preparing his noteworthy "Basic Course for Tile Setters." A report of his procedure may be found in the *Journal of Educational Research*, September, 1926.

[2] This phase of the offset pressman's trade, which in reality is merely a composite of operations described elsewhere in the analysis, is so important and distinctive in character that it is given specific attention.

A. Listing and Analyzing Offset Press Operations

1. *Entrance to Plants Where Trade Was Practiced.* The initial step consisted of deciding where to begin the work. Upon the recommendation of the Managing Director of the Foundation, who had already met several of the plant executives and the instructor of the evening class for offset pressmen apprentices conducted by the employing lithographers of New York City, it was decided to establish connections with the corporation where this instructor was employed as pressroom foreman and secure permission, if possible, to start the analysis there.

Arrangements were made to confer with the manager of the corporation in question. At this conference it was pointed out by the Managing Director that the prosecution of the educational program necessitated the preparation of suitable instructional material and that before such material could be prepared analyses of the various trades would have to be made. The request that the writer be granted the privilege of observing offset pressmen at work and of asking such questions of them and of the pressroom foreman as would enable him to secure the desired information was readily granted. Introduction to the pressroom foreman and his assistant, a working foreman, followed, and soon thereafter the investigator had his first glimpse of an offset press.

2. *Coöperation of Tradesmen.* From the very first, both the foreman and his assistant were most considerate, not once manifesting impatience or apparent unwillingness to answer what must often have seemed very simple, if not foolish, questions. It is possible that the investigator's frank declaration at the outset of his ignorance regarding the trade may have been partially responsible for the kindly attitude so persistently manifested. This fact is emphasized because of its possible bearing upon the success of the venture; for, without the good will and earnest coöperation of members of the trade, it would have been impossible for one unfamiliar with the trade to make headway in analyzing it.

3. *Terminology of the Trade.* It is generally conceded that in making a trade analysis one of the first necessities is to name the jobs or operations which comprise it.[3] But this cannot be done until the terminology of the trade is known. Accordingly, the

[3] "We may," observes Selvidge, "analyze (a vocation) on the basis of production units or on the basis of instruction units." R. W. Selvidge, *Individual Instruction Sheets*, Chap. II. By production units, Selvidge apparently means work jobs. He explains by illustration the meaning of instruction units, citing as examples the following: building a scaffold, mixing

investigator's entire time for the first few weeks was spent in observing offset pressmen and in asking questions. During this period, other departments in the plant were visited for the purpose of securing knowledge which might bear upon the pressman's trade and therefore upon the analysis. This phase of the experience could well be characterized as getting sufficiently well acquainted with the trade and related trades to be able to understand the meaning of terms used by offset pressmen.

4. *A Suitable Basis for Analysis.* At the end of two weeks, during which period the investigator had spent an average of 25 to 30 hours weekly in the pressroom, it was decided that trade operations rather than trade jobs would be the basis of procedure and that the following would be taken into consideration: (*a*) the name of each operation (or) *What to Do;* (*b*) the steps taken in performing each operation (or) *How to Do;* (*c*) the reason for performing each operation and for taking each step (or) *Why Do;* and (*d*) the knowledge needed in order to perform each operation (or) *What One Must Know.*

Up to this time, no assistance had been asked of coöperating tradesmen other than that they answer questions relative to specific operations, parts of the press, and so on. That aid of another character might be secured, the import of the decision to break the trade into its component operations was explained to them. Each readily complied with the request to prepare a list of trade operations. (In view of its bearing upon procedures of this character it should be noted that the total number of operations listed at this time by the two coöperating tradesmen was less than 40; while the number of operations finally included in the analysis totaled 85.)

5. *Different Makes of Presses and Practices in Other Plants.* It was early discovered that the make of the press was a factor to be reckoned with in the analysis. Accordingly, arrangements were made through the Managing Director to visit other plants for the purpose of observing other makes of presses in operation. The total list of operations was affected little by this. The few changes necessitated thereby had to do chiefly with the manner of performing important operations of distinctly mechanical nature.

cement mortar, plumbing a corner, setting flue lining, etc. Obviously, the instruction unit basis is largely, if not entirely, analogous to the operation basis employed by the writer in analyzing the offset pressman's trade.

While engaged in this part of the work, differences in pressroom practice, in so far as it was felt that they bore directly upon the analysis, were noted; for example, importance attached to cleanliness, variations in practice among pressmen with regard to the use of "dopes" in ink, significance attached to the maintenance of minimums and maximums in temperature and humidity in some plants and the resulting absence of certain types of register trouble, and problems connected with handling types of lithographing, such as labels, posters, show-cards, and art work. Notations regarding these and other differences were made and later incorporated in the analysis, or were used when preparing basic text material.

6. *Division of Trade into Blocks.* It was not until the investigator divided the trade into its four main divisions and systematically checked each and every part of the press involved in carrying these divisions through that the list of operations was rounded out. The technique used in this connection consisted of putting the following question to each part of the machine: "Does this part of the machine need to be set, adjusted, or cleaned by the pressman?"

7. *Conferences with Coöperating Foreman.* The work of the next few days consisted of continued observations and questioning for the double purpose of discovering additional operations and of finding out the steps involved in the performance of those already listed. At weekly intervals during the third month of the investigation the reconstructed list in typed form was submitted to the offset foreman for criticism. A personal conference[4] between the investigator and the foreman invariably followed the submission of revised lists. This enabled him to clear up misunderstandings, record suggested modifications, and otherwise improve the analysis.

From this time, the procedure consisted of continued observation for the purpose of detecting omissions and inaccuracies, of checking these up with the coöperating foreman, and of modifying the form and content of the analysis accordingly.

[4] These conferences constituted an important and vital part of the work. The investigator feels sure that the analysis could not have been satisfactorily completed except for conferences with the patient, practical and painstaking F. S. Garcia. The kind and courteous treatment shown to the investigator at this stage of the procedure by both pressmen and helpers also contributed appreciably toward the success of the work. It is indeed significant that, contrary to the expressed belief of some doubting "Thomases" when the analysis was begun, the investigator can testify that in not even a single instance did any pressman, union or nonunion, try directly or indirectly to obstruct his progress.

8. *Visits to Plants in Other Cities.* At the end of twelve weeks the investigator spent three days observing and questioning offset pressmen of the Ketterlinus Lithographic Manufacturing Company in Philadelphia, and three more days for the same purpose at the Niagara Lithograph Company in Buffalo. In each of these plants the analysis in typed form was read and criticized by the foremen of the pressroom and by three offset pressmen. Upon returning to New York City, the results of observations made and suggestions obtained in the above-mentioned plants were considered in a conference with the coöperating foreman after which they became a part of the analysis.

9. *Analysis Given to Lithographers in All Parts of the United States.* In February, 1926, at the end of the fourth month of the investigation, during which period the investigator had spent an average of twenty-five hours per week in lithographing plants, the analysis was completed. A mimeographed copy was then sent to the executive officer in each of sixty-seven lithographing establishments with a request for suggestions either in the form of corrections or additions.

This concludes the description of the technique used in listing and analyzing press operations. The technique observed when listing lithographing defects follows.

B. Listing Lithographing Defects with Their Respective Causes and Remedies

One of the most distinctive features of the offset pressman's trade consists of detecting and overcoming defects. To a large degree these defects appear on the sheet as it comes from the press; consequently, the importance of ability on the pressman's part (1) to recognize such defects, (2) to know their respective causes, and (3) to know how to overcome them is obvious. An analysis of the offset pressman's trade would be incomplete without a detailed list of such defects.[5]

1. *A Difficult Phase of the Analysis.* That this proved to be the hardest part of the analysis may be attributed to disagreement among pressmen not only as to the cause or causes of the various defects but also as to the respective remedies. Disagreement was found to prevail regarding the names of the various defects, as

[5] The technique observed in this connection is analogous in a way to that used by Charters in his famous study of errors in English.

well as ignorance on the pressman's part of the respective causes and remedies for many of them.[6]

In view of the above facts, the utmost care was exercised lest conditions develop that would impede the progress of the investigation.[7] In some instances many hours were spent in conferring with pressmen and others in an effort to find out the actual causes of, and correct remedies for a single defect. It is now believed that the investigator's manner of describing or stating certain defects, that is, by putting them in word form, was in part responsible for disagreement among pressmen. It is practically impossible to designate some of the lithographing defects so that even experienced pressmen can feel sure as to what is meant.

2. *Outstanding Feature of Technique.* The technique already referred to, namely, that of taking each part of the press or each phase of production and asking specific questions about it, was found highly useful in this connection. For example, blankets, plates, inks, water, paper, inking rollers, damping rollers, pressure and different feeder devices were considered in detail with the question in mind as to what defects, if any, appearing on the sheet when it comes from the press may be due to the condition of any one of these devices. Another important feature of the technique consisted of being on hand whenever troubles occurred and attempting to interview the foreman or a higher executive before or directly after the troubles had been overcome.

C. Listing Offset Inks and Associated Ingredients

Among the materials used continuously by offset pressmen, inks and the ingredients (reducers and driers) used when mixing them occupy a prominent place. While the analysis of offset press operations was in progress, consideration was given to ways and means of gathering the needed data on inks and the more important ingredients; but nothing definite was attempted until later. Upon completion of the analysis, proper attention was given to

[6] An interesting and instructive inference may be drawn from the experiences of the investigator in this connection. When he had detected twenty-four defects, his request to a half-dozen different pressmen to suggest additional defects availed nothing. By systematic observation, however, during the month preceding the final formulation of the analysis, the number of such defects was brought up to thirty-two. It was not necessary to change this number because of suggestions secured through the verifying procedure. Later, however, while preparing textbooks, the investigator succeeded in finding several additional defects. Apparently tradesmen cannot be depended upon solely for data of this type. These data must be secured from all available sources, and then painstakingly checked and rechecked in conference with tradesmen in order to insure accuracy.

[7] One principle kept constantly in mind was: Investigations of this character cannot succeed if the investigator discloses the source of his information.

the preparation of suitable forms for securing this new type of data. Forms 1, 2, and 3 (pages 11–13) represent not only the ideas of the investigator but those of several pressroom foremen, three factory superintendents, and two chemists in ink manufacturing plants.

1. *New Type of Technique Necessitated.* Because of the nature of the desired data and the different types of persons from whom they had to be secured, the following procedure was observed. Various foremen and pressmen were interviewed relative to the significant characteristics of offset inks and of the ingredients used in the trade when mixing such inks, the purpose of these interviews being to secure information that could be used as a guide in the preparation of suitable forms. Contact was then established with two new types of experts, namely, chemists in three ink manufacturing plants and heads of ink departments in two lithographing establishments. Forms 1, 2, and 3 resulted from these contacts.

The next step consisted of recording the ideas of one expert regarding the working properties of the various kinds of inks and of the several ingredients used both by pressmen and ink manufacturers when preparing inks. These ideas which, by the way, constituted the first draft of Charts 1, 2, and 3 were then compared with those of other ink chemists, foremen of pressrooms, offset pressmen, and foremen of ink departments. The personal interview method was employed exclusively. Following these interviews, Charts 1, 2, and 3 (pages 15, 16, 17) were formulated.

D. Determining the Nature of the Composite Operation, "Tending the Press"

The technique employed for finding out the nature of the work known as "tending the press during the run" is suggested by Form 4 (page 14). This form is the result of observation of the actions of several offset pressmen for a half hour or more while the presses were operating. By means of this form, every operation performed by several offset pressmen during one-hour periods was listed.

This concludes the description of the techniques used in securing the various kinds of data. The succeeding chapters will describe the results obtained from using the techniques just described.

FORM 1

NAMES OF THE VARIOUS BODY COLORS USED BY OFFSET PRESSMEN AND SIGNIFICANT FACTS REGARDING THE WORKING PROPERTIES OF EACH

NAME OF INK	WORKING PROPERTIES							SPECIAL CHARACTERISTICS
	Degree of Opaqueness	Degree of Permanency	Susceptibility to					
			Heat	Alkali	Alcohol	Acids	Acids in Water	
Yellows:								
Chrome Yellows								
Chrome Oranges								
Yellow Lakes								
Iron Blues:								
Milori								
Prussian								
Bronze								
Ultramarine								
Blue Lakes:								
Peacock								
Oriental								
Reds:								
Madder Lakes								
Mercury Vermilion								
Lithol Reds								
Purples and Violets:								
Permanent								
Fugitive								
Orange Lakes:								
Persian								
Permanent								
Greens:								
Green Lakes								
Chrome Greens								

Not all of the inks eventually included in the list are mentioned on this first form. The provision later made for securing information regarding the origin of the various inks is also missing from this form.

FORM 2

Ingredients Used by Offset Pressmen When Mixing Inks, and the Chief Working Properties of Each*

Name of Ingredient	Chief Working Properties								
	Reduces Both Depth and Strength of Color	Softens the Ink	Stiffens the Ink	Adds to Glossiness	Keeps Ink Flat	Makes Ink Dry Faster	Slows Up Drying	Increases Tackiness	Decreases Tackiness
Vaseline Compounds									
Paraffin Wax									
Kerosene									
Magnesia Powder									
Laketine									
Aluminum Hydrate Ink									
Covering White									
Mixing White									
Lard Oil									
Tallow									
Wool Grease									
Palm Oil									
Castor Oil									
Oleic Acid									
Mineral Oil									
Liquid Driers (Japan)									
Paste Driers									
00000 Varnish									
000									
00									
0									
1									
2									
3									
5									
7									
8									
Raw Linseed Oil									
Boiled Linseed Oil									

* See Chart 2 for purpose served by use of each ingredient.

FORM 3

SOURCE OF OFFSET INKS*

NAME OF INK	ORIGIN OF INK
Yellows:	
1. Chrome Yellows	
2. Chrome Oranges	
3. Yellow Lakes	
Blues:	
1. Milori	
2. Prussian	
3. Bronze	
4. Ultramarine	
5. Blue Lakes:	
a) Peacock	
b) Oriental	
c) Alkali	
Reds:	
1. Mercury Vermilion	
2. Red Lakes:	
a) Madder	
b) Para Reds	
c) Toluidines	
d) Lithol Reds	
Purple and Violet Lakes:	
1. Permanent	
2. Fugitive	
Orange Lakes:	
1. Persian	
2. Permanent	
Greens:	
1. Chrome Greens	
2. Green Lakes	

* See Chart 3 for significant facts regarding offset inks.

FORM 4

DIFFERENT OPERATIONS PERFORMED BY SINGLE-COLOR OFFSET LITHOGRAPHIC PRESSMEN DURING ONE-HOUR RUNS

NAME OF OPERATION	PRESSMAN *									
	A	B	C	D	E	F	G	H	I	J
Inspect Printed Sheet.										
Adjust Feed Screws...										
Push Ink Up to Rollers										
Dampen Plate.....										
Put Ink in Fountain..										
Put Water in Fountain										
Scrape Ink Off Drum or Rollers.....										
Put Water on Dampers										
Clean the Blanket....										
Etch the Plate.....										
Put Ink on Rollers...										
Patch the Blanket....										
Polish the Plate.....										
Adjust Dampers.....										
Mix Additional Ink for Run.....										
Add Varnish to Ink in the Fountain.....										
Gum Up Plate.....										
Adjust Feeder.....										

* The letters A, B, C, etc., represent different pressmen.

CHART 1

Working Properties of Various Body Colors Used by Offset Pressmen

Name of Ink	Working Properties							
	Degree of Opaqueness	Degree of Permanency	Susceptibility to					Special Characteristics
			Heat	Alkali	Alcohol	Acids	Acids in Water	
Yellows:								
Chrome Yellows	Large	Large	Good	Poor	Good	Good	Good	Heavy inks
Chrome Oranges	Large	Large	Good	Poor	Good	Good	Good	Heavy inks
Yellow Lakes	Small	W. var.	W. var.	W. var.	Usually bleeds	W. var.	Usually good	Bulky inks
Iron Blues:								
Milori	Medium	Large	Good	Poor	Good	Good	Good	Med. bulky
Prussian	Medium	Large	Good	Poor	Good	Good	Good	Med. bulky
Bronze	Medium	Large	Good	Poor	Good	Good	Good	Med. bulky
Ultramarine	Medium	Large	Fine	Good	Good	Poor	Medium	Poor working ink
Blue Lakes:								
Peacock	Small	Usually fug.	W. var.	W. var.	Usually bleeds	W. var.	Good	Tends to brilliancy
Oriental	Small	W. var.	W. var.	W. var.	W. var.	W. var.	Good	Tends to brilliancy
Alkali Blues	Small	Medium	Medium	Medium	Usually bleeds	Good	Good	Tends to brilliancy
Reds:								
Madder Lakes	Very small	Large	Good	Good	Fairly good	Good	Good	Bulky inks
Mercury Vermilion	Large	Large	Medium	Good	Good	Medium	Medium	Poor working ink
Para Reds	Medium	Large	Medium	Good	Poor	Good	Good	Bleeds
Toluidines	Medium	Large	Medium	Good	Medium	Good	Good	
Lithol Reds	Medium	Medium	Good	Good	Medium	Good	Good	
Purples and Violets:								
Permanent	Medium	Large	Good	Good	Medium	Good	Good	
Fugitive	Medium	Small	Good	Poor	Poor	Good	Good	
Orange Lakes:								
Persian	Very small	Very small	Medium	Poor	Medium	Medium	Good	
Permanent	Very small	Large	Medium	Good	Medium	Good	Good	
Greens:								
Green Lakes	Very small	W. var.	W. var.	W. var.	Medium	Medium	Good	Tends to brilliancy
Chrome Greens	Large	Large	Large	Poor	Good	Good	Good	Heavy ink

W. var. = Wide variation; Fug. = Fugitive; Med. = Medium

1. Heavy has reference to gravity, not to body.
2. A pound of bulky ink on same form will go further than a pound of heavy ink.
3. Some peacock blues are quite permanent, but when so they lack the brilliancy of fugitive blues.

CHART 2

VARIOUS INGREDIENTS USED BY OFFSET LITHOGRAPHIC PRESSMEN, AND THE PURPOSE SERVED BY EACH

NAME OF INGREDIENT	CHIEF WORKING PROPERTIES								
	Reduces Both Depth and Strength of Color	Softens the Ink	Stiffens the Ink	Adds to Glossiness	Keeps Ink Flat	Makes Ink Dry Faster	Slows Up Drying	Increases Tackiness	Decreases Tackiness
Vaseline Compounds	†				x		x		x
Paraffin Wax	x		x						x
Kerosene	x	x			x		x		x
Magnesia Powder	x		x		x			x	
Laketine	x				x				x
Aluminum Hydrate Ink	x			x				x	
Covering White	x								
Mixing White	x								
Lard Oil	x	x			x		x		x
Tallow	x				x		x		x
Wool Grease	x				x		x		
Palm Oil	x	x					x		x
Castor Oil	x	x					x		x
Oleic Acid	x	x					x		x
Mineral Oil	x	x					x		x
Liquid Driers (Japan)	x	x		x		x			x
Paste Driers	x			x		x			
00000 Varnish	x	x			x				x
000	x	x			x				x
00	x	x			x				x
0	x	x							x
1	x	x							
2	x	x							
3	x								
5	x		x	x				x	
7	x		x	x				x	
8	x		x	x				x	
Raw Linseed Oil	x	x							
Boiled Linseed Oil	x	x			x	x			

CHART 3

SOURCE OF OFFSET INKS*

NAME OF INK	ORIGIN OF INK
Yellows:	
1. Chrome Yellows	Lead Chromates with Varnish
2. Chrome Oranges	Lead Chromates with Varnish
3. Yellow Lakes	Coal Tar Dyes on Suitable Base with Varnish
Blues:	
1. Milori	Iron Ferro-Cyanides with Varnish
2. Prussian	Iron Ferro-Cyanides with Varnish
3. Bronze	Iron Ferro-Cyanides with Varnish
4. Ultramarine	China Clay, Sulphur, etc., Fused, Then Mixed with Varnish
5. Blue Lakes:	
a) Peacock	Coal Tar Dyes on Suitable Base with Varnish
b) Oriental	Coal Tar Dyes on Suitable Base with Varnish
c) Alkali	Coal Tar Dyes on Suitable Base with Varnish
Reds:	
1. Mercury Vermilion	Mercury Sulphide with Varnish
2. Red Lakes:	
a) Madder	Coal Tar Dyes on Suitable Base with Varnish
b) Para Reds	Coal Tar Dyes on Suitable Base with Varnish
c) Toluidines	Coal Tar Dyes on Suitable Base with Varnish
d) Lithol Reds	Coal Tar Dyes on Suitable Base with Varnish
Purple and Violet Lakes:	
1. Permanent	Coal Tar Dyes on Suitable Base with Varnish
2. Fugitive	Coal Tar Dyes on Suitable Base with Varnish
Orange Lakes:	
1. Persian	Coal Tar Dyes on Suitable Base with Varnish
2. Permanent	Coal Tar Dyes on Suitable Base with Varnish
Greens:	
1. Chrome Greens	Chrome Yellows, Iron Blues with Varnish
2. Green Lakes	Coal Tar Dyes on Suitable Base with Varnish

* Major sources only are given.

CHAPTER III

RESULTS OF THE ANALYSIS

The results of the analysis appear in four parts or divisions, namely: (A) Offset Press Operations; (B) Lithographing Defects, With Their Respective Causes and Remedies; (C) Offset Inks and the Ingredients Used When Mixing Such Inks; (D) Making the Run. The first two of these divisions will be discussed in this chapter.

A. Offset Press Operations

The material on offset press operations found on pages 19 to 56, inclusive, gives the names of the operations performed by offset pressmen, the steps taken in performing each of these operations, the reasons for performing the operation and the major steps of which it consists, and, finally, the knowledge essential to a thorough understanding of the operation. The material on lithographing defects (page 57) includes the names of the various defects which appear on the sheet together with their respective causes and remedies. The grouping employed in the press operations phase of the analysis is not the result of an arbitrary decision even though it does not entirely conform to that employed later when preparing the basic texts.[1]

This difference between the two groupings, which as a matter of fact is so slight that only a close observer would notice it, is no more than should be expected when a trade is approached from somewhat opposite angles. It is no doubt partially accounted for by the investigator's having become more familiar with the terminology of the trade; but a clearer understanding of what constitutes trade practice probably also played an equally important part.

[1] The difference between the titles and content of the different divisions in the analysis and in Unit I, *Operating the Press*, is not marked. An attempt to ascertain by scientific means what operations should be included in each of the four divisions of the press operations was abandoned because of disagreement among pressmen and foremen. One result of the attempt was the discovery that the method of grouping operations followed by cost accounting and estimating departments in lithographing plants is not acceptable to offset pressmen.

GROUP I

Operations Chiefly Connected with Getting Ready To Run Trial Impression

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
1. Gumming Plate Before Washing It Out.		
Rub surface of plate with sponge which has been dipped in gum arabic solution. Rub plate with soft rag until gum entirely covers it. Spread gum out evenly by going over plate at least twice. Fan plate until dry.	To cover up any abrasions due to scratches so that the plate may not take ink and print. To insure the removal of particles of dust that have collected on plate. The gum picks these particles up and removes them later when the plate is washed with tincture solution.	Meaning of terms—gum arabic solution, sponge, soft rag, fan, etc. How to use materials to accomplish purpose. Kind of care necessary and how to exercise it.
2. Washing Plate Out With Tincture.		
Secure tincture and soft rag free from buttons. Pour enough tincture on plate to cover with thin film when spread out by means of rag. Rub plate thoroughly with rag, especially the sensitized parts. Remove remaining tincture with dry rag but do not rub more than is necessary to accomplish purpose, being careful to rub with light rotary motion.	When the plate reaches the pressman it is covered with rosin and ink in somewhat hardened form. If these were not washed off with tincture, a mixture of asphaltum and turpentine, the printed sheet would look "spotty." (In some plants the plate is ready to put on the press when the pressman gets it.)	Meaning of terms—tincture, soft rag, etc. How to use materials to accomplish purpose. Kind of care needed and how to exercise it.
3. Cleaning Back of Plate.		
Rub palm of hand over surface to locate unevenness. Remove particles of gum or other substance adhering to surface of plate. Wash thoroughly with rag and kerosene. (Some	Perfect lithographing is possible only when the surface of the cylinder is smooth and regular. Foreign substances such as dirt or rosin which sometimes cling to back of plate	Meaning of terms—kerosene, turpentine, rosin, soft rag, etc. How to detect and overcome unevenness on back of plate.

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
pressmen prefer turpentine.) Water must be used to remove gum which is soluble only in water; gasoline to remove rosin. A dull knife may be needed.	must therefore be removed.	
4. Placing Marks on Plate. For end marks: Place straight-edge bar on surface of plate with edge of bar falling on gripper marks running parallel to end of plate. Draw line in from each edge of plate one-half inch, using pointed steel pencil and holding it close against edge of bar which is on gripper marks. If first plate on job, place plate on table with sheet to be run in position on it (as it will be printed). Pencil mark the edge of sheet opposite the side gauge mark and measure distance from mark to cylinder bearer. For side marks: Place unmarked end of gauge stick on end mark opposite the gripper mark with stick extending along edge, lengthwise of plate. Mark plate with sharp pencil at point where mark from last plate was placed on stick.	This is done so that pressman will know when plate is exactly straight on cylinder. If gauge marks are exactly right, correct register may be expected without touching the guides. Such exactness is, however, rarely ever attained, so pressmen do not expect it.	Meaning of gripper marks, gauge stick, straight-edge, steel pencil. How to use various tools accurately.
5. Measuring Thickness of Plate. Place plate between the jaws of the micrometer. Screw jaws together and the ratchet down as far as possible.	Plates vary in thickness up to several thousandths of an inch; also individual plates vary considerably in	How to manipulate the micrometer. How to read micrometer. Appreciation of ne-

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
Read while instrument is on the plate. (Never rely upon one measurement.) Find thickness in four or five places, then take average of same.	thickness in different parts of the plate. The "cut-out" or distance which the surface of the bearers is above the surface of the cylinder is constant and is known by the pressmen. If it is .031 of an inch, for example, then the pressman must know the exact thickness of the plate before he can determine how much "packer" must be put under the plate in order to make the pressure right.	cessity for exactness. Meaning of various terms.
6. Building Up Blanket or Plate or Determining Packer Needed.		
Determine by means of the "mike" how many thicknesses of paper should be placed under plate or blanket in order that pressure may be O.K. The pressure required for good lithographic printing is from .004 to .0045 thousandths of an inch, which amount should be evenly divided between the two cylinders. Secure necessary sheets. Remove plate or blanket to the extent necessary and place required number of sheets underneath, being careful to keep sheets flat. Replace plate or blanket, as case may be, on cylinder by method elsewhere indicated. New blankets tend to swell slightly.	If all plates and blankets were of the same thickness and blankets did not wear down or flatten out (lose their resiliency), this operation would be unnecessary so far as blankets are concerned. Both are built up, that is, are raised by placing sheets of paper, "packers," between them and their respective cylinders, in order to bring the pressure up to where it should be for good printing, and to the point also where the pressure-set screws can make the fine adjustments.	Meaning of terms—how to use micrometer ("mike"), how to place sheets under plate or blanket. Understanding of relationship between cylinders, of how all diameters on both cylinders are uniform and must be kept so, and of the inevitable result if such uniformity is not maintained. Appreciation of fact that diameter of cylinder is slightly increased by swelling of blanket.

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
7. Putting Plate on Cylinder.		
Rub palm of hand carefully over entire surface of cylinder. Whether the gripper or the back end of the plate is to be put in first depends upon make of press. Insert end of plate in clamps. Tighten clamps. Adjust check screws so that gauge marks tally with marks on cylinder. Revolve cylinder until clamps for other end of plate are easily accessible. Insert gripper end of plate in clamps and tighten. Tighten check screws, being careful to tighten each from two to three times by working back and forth, rather than by turning each up tight on first turn. Tighten until marks on plate and cylinder tally, then see that all screws are equally tight. Do not overtighten. Revolve cylinder again and see that marks are still O.K. on back end of plate and that check screws are properly tightened. (The mechanism, which holds plate to cylinder, varies considerably on different presses, but the method of putting plate on is fairly well standardized. In some cases the edge of plate must be bent over to an angle of 30 degrees or so before inserting same in clamps.)	This is to insure the removal of any foreign substance that may have gotten on cylinder and which, if not removed, interferes with pressure. The plate carries the design to be printed and must therefore be put on cylinder so that inking and damping may take place. Care is necessary in putting plate on cylinder in order to insure correct register. Then, too, it is possible to stretch plate out of shape by overtightening. The important thing is to see that register marks tally exactly, though even this will not insure against the necessity for further adjustments.	Appreciation of necessity for removing all particles of dirt, gum, etc., from cylinder surface. Meaning of terms—clamps, gauge marks, check screws, gripper end of plate, etc. How to handle plate and tools. Realization of need for exercising care and of getting the "feel" essential to correct adjustment.

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
8. Damping the Plate.		
See that fountain contains plenty of water. Throw damping lever on. Start press. If in hurry to start run and press has been standing for any length of time, rub sponge over entire length of dampers. Some pressmen sponge plate thoroughly before throwing dampers on. The important thing is to see that plate is damp before ink touches it.	The plate is kept damp so that it may not take ink (become inked) except on the work (greased or inked) portions. The damping consists chiefly of a mixture of gum arabic and water which has been carefully prepared. The dampers distribute a thin film of this mixture over the plate. When the ink rollers strike the plate, they really distribute ink over the work (or design) portions only.	Meaning of terms—damping lever, dampers, work, etc. How to throw damping lever on. Realize necessity for correct damping mixture and proper damping. Appreciate danger of chromic poisoning. (Some plants do not use chromic acid because of this danger.) Understand close relation between strength of fountain water and the kind of plate, work on the plate, ink, paper, and length of run.
9. Placing Ink in Fountain.		
Run broad knife (sometimes palette knife is used) under portion of mixed ink, and get as much on blade as can be handled safely. Lift knife with ink from table, keeping the blade up and at an angle of 45 to 65 degrees, and turning the whole by means of handle as rapidly as necessary while moving to the ink fountain. Spread ink along fountain and see that it is up against fountain roller.	Even and regular distribution of ink is absolutely essential to good presswork. Modern ink fountains are designed to accomplish this. Good lithography calls for utmost cleanliness; therefore, the necessity of being careful not to spill the ink when taking same to fountain.	Meaning of terms—broad knife, palette knife. How to handle knives when carrying ink. Appreciation of necessity for cleanliness.
10. Inking the Rollers. (Inking Up)		
See that ink is distributed evenly in fountain and that it is up against fountain roller. Set fountain for run in	Rollers are inked before starting to run the trial impression so that the first sheets will be properly inked.	Meaning of terms—fountain, fountain roller, fountain "catch," trial impression, etc. How to set fountain,

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
accordance with nature of work on plate. Put fountain "catch" on. Throw inking lever on. Run press until rollers are properly inked. (The period of time required for this varies, depending upon the composition of the ink, from 3 to 6 or more minutes. Often the pressman puts ink directly on the rollers and in this way speeds up the inking process.)	Ordinarily the pressman does not get the ink to feed properly until several trial impression sheets have been run.	put ink up against rollers, start press and throw inking lever on when rollers are inked properly.
11. Setting Ink Fountain. The fountain feed is regulated in two distinct ways: (1) by the fountain screws forty or more in number, and (2) by a ratchet on gear wheel of fountain roller. In setting fountain for a new run the pressman proceeds as follows: sees that ductor roller does not contact with fountain roller; regulates set screw on the arm which controls ratchet so that fountain roller will turn desired distance to each revolution of the cylinder. (This distance is not standardized.) Every pressman has learned that he needs a different flow or feed of ink for some jobs than he does for others; likewise, that some inks flow more freely than others. A safe starting point is to set roller so that it turns three-fourths of its maximum at each revolution of cylinder. If flow of ink is too free, reduce distance (number of cogs covered by the ratchet per each cylinder revolution; if	If good work is to result, it is necessary that the amount of ink passing to the plate and sheet shall be carefully controlled. To this end, the pressman takes considerable time in getting the fountain set just right for the run. Not that he does not need to make adjustments later, for there is always necessity for fine adjustments of fountain screws while the run is being made; but experience has shown the advisability of getting the fountain feed approximately right before starting the run.	Meaning of terms—fountain feed, regulating devices, etc. How to regulate devices controlling flow of ink. Appreciation of necessity for taking time to make careful adjustments and of proceeding slowly and cautiously.

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
flow is not sufficient, increase the distance traveled by ratchet.) To regulate distribution of ink along the rollers, that is, to increase or decrease the amount at any one point on rollers, the fountain screws are loosened or tightened, as the case may be.		
12. Setting Front or Gripper Guides.		
Since the nature of these guides on different types of presses varies considerably, it is impossible to describe the operations with any exactness. In all instances it is simple, consisting chiefly of loosening screws, shifting guides, and tightening screws again. When setting these guides the grippers should always be in plain sight, and the guides set so that there is no danger of the grippers clamping down on them.	Guides serve the important purpose of controlling the sheet so that it enters the press exactly at the place and time essential to accurate register. These particular guides, sometimes known as "stop" guides, hold the sheet so that when the grippers come along, the sheet is at exactly the right place for them to grab it and take it on around the cylinder. If not set correctly, the feeding mechanism cannot cooperate properly with the printing mechanism.	How guides coöperate with grippers and the mechanism controlling such coöperation; the purpose of these guides; how to use them; what tools to use and how to use them; what additional materials are needed and how to use the same; also the need for care.
13. Comparing Ink Mixture with Proof.		
Take small quantity of mixture on tip of knife blade—pressmen sometimes use the finger tip. Spread ink just as thin as possible on clean sheet of paper. Compare with proof by placing close to it. Some pressmen always make the comparison by looking	The pressman is required to reproduce the proof in color, finish, general effect, etc. It is important, first of all, that the ink shall be of the correct shade. The quality of the finish, i.e., the amount of gloss, the	How to spread ink out so as to insure reliable comparison. How to discover similarities and differences in inks. (Adequate color sense is indispensable to satisfactory performance of this work.)

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
through a small opening in a piece of paper.	speed of drying necessary, etc., is taken care of later. By limiting the field of vision, more accurate comparison is made possible.	
14. Mixing Ink to Match Proof. (The proof book tells the pressman what color and shade of ink to mix for each run, but it gives no instruction regarding the ingredients to be used in order that the ink may be of the right consistency.) Take amounts of ink considered adequate for the run from the different cans and place same on table. Mix inks by means of palette knife and broad knife, being careful that the darker color is added to the lighter rather than the opposite, and that not too much is added. Add varnish and other ingredients to suit, bearing in mind that any ingredients added reduce the strength of the color proportionately. Mix thoroughly. Add more of any one ingredient if mixture does not look or feel right. (The pressman is concerned first of all with getting the right shade. He takes care of the consistency feature after his shade of color is satisfactory. It is impossible to indicate definitely just how to mix ink in order to match a proof; for even when colors and shades of ink to be used have been indicated,	The ink as it comes from the can, even if it should happen to be the exact color needed, may or may not be of the right consistency. The pressman must mix ink, varnish and drier to secure mixtures of correct color and consistency. Where many colors are placed on the same sheet of paper, it is important that each color be of the correct shade if the final product is to be satisfactory. On very fine work the pressman is extremely careful regarding the accuracy of the shades of color printed. In offset printing very strong inks are used as this is the only way to gain the result secured in direct printing by piling ink up. It is absolutely necessary, therefore, to keep the ink strong, i.e., not weaken it too much.	Meaning of various descriptive terms connected with ink mixtures. Names of various inks and ink ingredients. What ink to mix in order to secure a certain shade of color. What ingredients to add to body colors to secure various shades and right consistency. Results to be expected from adding specific amounts of any one ingredient to mixture. Realization of necessity for exercising care. How to mix inks thoroughly. How temperature, nature of the work and paper affect ink and vice versa, and necessity of always considering these when mixing the ink. Inadvisability of "monkeying" with the ink; the importance of getting it right, then leaving it alone.

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
the pressman must still resort to experimentation. In other words, he must mix his ink in conformity with the demands of the run, in terms of the paper upon which the printing is to be done, the nature of the plate and the atmospheric conditions.) Even after mixture matches the color of the proof and is apparently of right consistency, the pressman may find that ink does not show up correctly on his trial impression. If such proves to be the case, he continues experimenting until the results are satisfactory.		
15. Setting the Skeleton Wheels. Determine point to which wheels are to be shifted by running sheet of width to be run through the press to the wheels. Loosen set screws. If possible, shift wheels on shaft so that they are opposite blank spaces. Tighten set screws. (On modern presses the part of skeleton wheel which touches sheet is very narrow. A saw-tooth edge is found on some presses.)	The purpose of the skeleton wheels is to provide a safe means of transferring printed sheets from cylinders to conveyer. Since sheets used for the different order jobs vary considerably in width, it is necessary to shift the skeleton wheels on the shaft so as to meet the varying demands.	Purpose served by skeleton wheels. How to determine point to which wheels are to be shifted. Tools needed for operation. How to use tools to accomplish purpose.
16. Setting Grippers on Impression Cylinder. Loosen all grippers. Place pieces or strips of paper to be used for run under each gripper. See that distance between rod near tumbler and the tumbler is .004 to .005 inches.	Unless the grippers are adjusted to the width and thickness of the sheet of paper, the printing mechanism cannot do its work properly. Certain reg-	How the grippers should operate. How to set grippers properly. Tools and materials needed.

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
Tighten grippers from center out until "feel" is same on all, the same to be tested by means of paper slip under each gripper. Sometimes the gripper at extreme edge of sheet does not get a good grip and must therefore be thrown open in order that it may not cause bad register.	ister troubles are due chiefly to improper adjustment of grippers. All grippers must clamp down at the same time and with equal force.	How to use tools and materials.
17. Setting Form Rollers. (Method varies somewhat on different presses.) Loosen all check screws. See that gear wheel on rider meshes perfectly with gear wheel on cylinder. Set form rollers to plate. Run plate under form rollers and drop down with riders in place. Set each form roller so that .003 strips of paper under each end pull evenly and fit snugly. Lock roller sockets and turn press until rollers are in gap on cylinder. Adjust rider to form rollers. Turn press until rollers are on plate and retest with paper slips. See that rollers remain in constant contact with plates. Tighten all check screws.	Proper contact must be established and maintained between form rollers and riders; also between intermediate rollers and drum, or ink will not be transmitted and distributed properly. Roller marks and tinting will result unless rollers contact properly with plate.	Specific work of the form rollers and riders. How rollers and riders must be set in order to do their work properly. How to set rollers and how to check to see if they are set correctly. Tools necessary and how to use them.
18. Setting Side-Guides on Hand-Fed Press. Measure distance from end of cylinder to guide marks on plate. Measure same distance in from side of feed board at point where guide is situated and place mark.	Since the side guides are for the purpose of controlling the sheet so that it enters the press at exactly the right place, and since the design on different	How to determine point where side guides are to be and how to set them properly. Tools necessary to perform the operation.

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
Allow sufficient distance from mark toward nearest side of the feed board to account for border on printed sheet.	plates is not always the same distance from the edge, it is necessary to shift the side guides so that they can do what they are expected to do.	
19. Cleaning Grained Rollers.		
Cover roller with benzine; turpentine and kerosene are also used. Scour roller surface vigorously with No. 2 grade of sand paper. Go over roller at least twice with scraping knife. Repeat above operations in order named until roller is cleaned. Use gasoline for last washing.	These rollers are used in place of the composition and the rubber rollers by some pressmen. The necessity for cleaning is the same in all cases. If ink for next run is dark and rollers have dark color on them, then washing need not be as thorough as if next color is light. Benzine is preferable as it leaves no grease and dries quickly. Its high inflammability has caused legal restrictions to be placed on its use in certain states. Gasoline is best for last washing as it evaporates rapidly.	Materials and tools necessary. How to use the tools and materials to accomplish purpose. Appreciation of the necessity for thoroughness. High inflammability of benzine and need for care when using it.
20. Setting Draw Guides.		
Measure distance that border of design or sensitized portion of plate is from end of cylinder. Measure same distance in from side of feed board and mark point. Place guide at mark, then pull it back enough to allow for border on printed sheet. Tighten set screw.	Draw guides are used less frequently than the side push guides referred to elsewhere. On hand-fed presses sometimes the feeder must draw or pull rather than push the sheet, in order that it may enter the press in the manner and place necessary for correct registration.	How to determine point at which to set guide. How to set guide. The tools necessary and how to use them to accomplish purpose.

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
21. Taking Ink from Fountain. Remove ink with broad knife. Wash remaining ink out with benzine or kerosene on rag. Wipe fountain clean with dry rag. Sometimes fountain blade must be entirely removed for cleaning.	This is done in order that new ink may be put in. It is also necessary sometimes when fountain is not feeding properly and relief cannot be gotten through adjustment of feed screws.	The tools and materials necessary for operation and how to use them to accomplish purpose. The necessity for doing task thoroughly. Understanding of inking mechanism.
22. Examining Plate Before Putting It on Press. This operation is very important and consists in looking the plate over carefully, comparing the various designs on it for uniformity, amount of work, firmness; noting the grain, color of plate, stains, etc., then comparing each part carefully with proof book to see what may be expected.	This is what might be called "playing safe" on the pressman's part. If he feels that trouble is almost sure to arise when he gets the plate on the press, he reports same to his foreman and thus protects himself against any "passing-the-buck" possibilities.	How design should look in order to print well or according to proof book. How to compare parts of design with each other and with proof book.
23. Removing Plate from Cylinder. Loosen check screws on gripper end of plate. Loosen all clamps and pull plate out of clamps. Revolve cylinder, being careful to hold plate away from press until clamps at other end of plate are easily reached. Loosen check screws on other end of plate. Loosen clamps and remove plate. (It is a common and approved practice to gum the plate and rub it smooth when it is removed from the cylinder.)	When the run for a certain color or design is completed, or when the plate proves to be unsatisfactory, it is removed. In case the design on the plate needs to be built up, the plate may be taken off at one end only. The gumming and rubbing down smooth are to insure preservation of work on plate.	What screws and which to loosen first. How to manipulate press so as to cause cylinder to revolve in right way. What tools to use and how to use them to remove plate. How to gum plate and rub down smooth.

GROUP I (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
24. Washing Ink Rollers. Take rollers off press and place on rack. Rub each roller with rag saturated with kerosene or a similar liquid. Follow up with a dry rag. Repeat until rollers are clean. Place rollers back on press. Special care should be taken not to bend spindles or mar rollers in any way.	It is necessary to clean rollers whenever the next run calls for a different color. If the color to be used next is almost the same shade and is dark or light the same as the color on the rollers, a partial cleaning suffices. The rollers are placed on the rack when a thorough cleaning is necessary because it is impossible to do the work otherwise.	How to take rollers off press. How to clean rollers. The different materials needed. Necessity for being careful not to bend spindles or mar roller surfaces. (This applies especially to composition rollers.)

GROUP II

Operations Chiefly Connected with "Getting the Lay"

Almost all adjustments are listed in this group. This arrangement is resorted to because there is always the possibility that a setting (see Group I) will prove incorrect.

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
25. Adjusting Pressure on Impression Cylinder. Procedure is the same as in case of plate and blanket cylinders if the press has no special mechanism for changing pressure. If this device is on press, the operation is simply a matter of tightening or loosening the pressure screw; otherwise the blanket must be built up. Where the impression cylinder carries a blanket this may also need building up. In general the procedure is: 1. Take two 2-inch strips of the stock to be run and place one on each end of impression cylinder. 2. Put on pressure and adjust screws until paper slips can barely be removed. 3. Add amount needed for proper pressure.	Quite often it happens, particularly on presses which have a special device for changing the pressure, that the pressman finds it necessary to increase or decrease pressure when he starts to print. This may be due to the ink having a different consistency or to the fact that the amount of ink demanded to secure the desired effect on the sheet is greater or smaller than in the last case.	When adjustment is necessary. How to make the adjustment. If "packer" must be used, pressman must know how to determine where to put it in order to prevent register trouble, etc.
26. Adjusting Automatic Feed Devices. (*a*) cones; (*b*) feet; (*c*) blowers; (*d*) suction devices; (*e*) bars; (*f*) push fingers; (*g*) pulleys, etc. Automatic feeders differ. Any attempt to describe the operations would be of no value, therefore, unless the particular feeder were named in connection with the description. This seems unnecessary because of the	The reason for making the adjustments is obvious since the feeder is responsible for getting the paper into the press at the exact time and place required for proper register. Each particular device has its work to do and must, therefore, be adjusted correctly. If	Must understand the mechanism of each device and how it does its work. How to make necessary adjustments. What tools are necessary and how to use them for the purpose intended. High degree of accuracy is necessary.

GROUP II (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
comparative ease with which the adjustments may be made. For, notwithstanding the high grade of work done by these feeders, the mechanism is easy to understand and to adjust. The push fingers must always be set so as not to mar the sheet already printed, and the blowers so that they loosen top sheet only.	any one of them is out of adjustment, the one next in line cannot do its work properly.	
27. Adjusting Automatic Piler Devices. These devices vary on the different presses. Piling is simple when compared with feeding. At times, however, it is practically impossible to pile the sheets well enough to feed without rehandling. The adjustments are fewer and just as easy to make as on the feeders.	In order that the automatic feeder may do its work properly, the sheets must be piled very evenly. There must be no variation to speak of in the way each sheet comes in contact with the devices which carry it to and through the press.	What the particular device is supposed to do and how it operates. How to make the necessary adjustments. Tools necessary and how to use them.
28. Adjusting Cams for (Timing) the Front-Guides and for Controlling Straightness of Sheet, Etc. Different makes of presses have different devices for accomplishing these objects. It would be necessary, therefore, to describe all in order to be thorough. This, however, would be unwise since the "cam" arrangement is common to all presses. The way to shift the mechanism, in order that the desired result may obtain, can soon be learned.	It is not difficult to understand the reason for carefully timing the feeding, printing, and delivery of mechanical devices when it is known that sheets pass through the press at the rate of 3,000 to 3,500 an hour, or almost one a second. Since the cylinders are set to coöperate perfectly, the feed and delivery mechanisms are adjusted accurately to	Nature of timing mechanism. What tools to use; How to adjust in order to bring about complete accord between grippers and guides.

GROUP II (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
	the cylinders. The timing must be approximately perfect if trouble is to be avoided. The same is true of other cams on the feeder.	
29. Changing the Consistency of the Ink. The method of procedure varies with different pressmen and with the ends sought. In general, it may be said that different grades and amounts of varnish are used: (*a*) To increase glossiness of finish; (*b*) To make the color sharper or details clearer; (*c*) To counteract greasiness, i.e., shorten or stiffen ink; (*d*) To reduce strength of color; (*e*) To make ink soft and loose rather than stiff and stringy. Different kinds of driers are used to increase drying qualities of the ink. More body color or pigment is added to increase the strength or depth of color.	Since it is impossible for the pressman to know whether or not his ink mixture will be of the consistency demanded by the particular job, the best he can do is to approach it as closely as possible, then change it to suit. An ink must give the right finish, have the right "tack" or adhesiveness, and be of a consistency that will dry at the right rate of speed, whether on coated or uncoated paper, on a slow or fast-running press, for a short or a long run, etc. All told, there are at least 13 factors which pressmen must reckon with when mixing inks for various jobs.	What needs to be done. What effect each ingredient has when added. The various ingredients that may be used for the particular job. How to use the different ingredients. How to test new mixture and determine degree of satisfactoriness. Necessity for exercising care so as not to add too much of a certain ingredient.
30. Adjusting Feed Slides on Certain Presses. (These are very small parts of the press, but they play an important part in good presswork.) Loosen screws which hold slide. Place small piece of cardboard, say, .02 inches in	If the object of the slides is to be realized, they must be adjusted so that the sheet passes over them readily and on into the press without friction. At the	The kind of adjustment needed. What tools are needed, and how to use such tools in making adjustments.

GROUP II (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
thickness, between slide and cylinder. Tighten slide screws. (Be sure that the cardboard, after the screws are tightened, actually represents the distance between the slide and the cylinder.)	same time, they must not rub the surface of the cylinder. So long as sheets of different sizes are run through certain presses, it will be necessary to adjust guides so that they do what they are intended to.	
31. Securing the Foreman's O. K. Usually the foremen of the pressroom and of the art room, respectively, are consulted when an O. K. is sought. Suggestions relative to further printing are noted by pressman.	Unless this is done, the pressman may justly be blamed for any mistakes that might occur. It is assumed that the specialist or the man with more experience knows what is right better than the pressman.	
32. Building up Impression Cylinder. Determine through examination of the printed sheet how much the cylinder needs to be built up (increased in diameter). Paste desired thickness of paper around cylinder. If cylinder surface consists of removable plate, remove the plate, put desired thickness of paper under it, and replace plate. The check used by pressmen for determining whether or not the impression cylinder must be built up is the simple one of seeing if impression on blanket is O. K. If it is not, then the pressure is not O. K. between plate and blanket.	This is done sometimes in "rush" orders when paper has stretched slightly (.005 to .035), since last run was made, thus causing inaccurate register. Increasing the circumference of the impression cylinder has the effect of shortening or drawing the sheet in (taking stretch out) and thus of correcting the register.	How much "packer" to put on cylinder. How to put "packer" on properly.

GROUP II (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
33. Adjusting Pressure Screw on Cylinder. (This operation is possible only on presses which have a special pressure-adjusting device.) Loosen lock screw. Adjust pressure: turn to right to increase and to left to decrease pressure. Tighten lock screw. If pressure-adjusting device is on each end of cylinder, care must be taken to adjust each the same distance.	Within limits, pressure is controllable by special devices. If ink being transmitted to the sheet is insufficient in amount, the pressure is increased slightly to correct the condition.	How the pressure device works. How to make necessary adjustments.
34. Adjusting Draw Guides. Loosen screws. Move guide distance necessary to correct register. Tighten screws.	This is the only way to correct certain types of inaccurate register.	How much and in which way to adjust them to accomplish specific purpose.
35. Adjusting Ink Fountain Feed. The inking mechanism seems to be well standardized. The screws which control the feed are placed at close intervals underneath fountain and are easily adjusted. Turn to right to decrease flow, to left to increase flow. The good pressman makes slight adjustments, preferring to make several adjustments, if necessary, rather than overdo the first time.	The amount of ink made available for the ink rollers to distribute to the plate is determined largely by the screws. It is essential, therefore, that they be set properly. It is impossible to turn out a first-class color job unless the amount of ink reaching the rollers is thus determined. Placing ink directly on the rollers is an objectionable practice and is never resorted to when the highest type of work is being turned out. (It is assumed here that the pressman has his fountain feed	Which way to turn the screws to increase and decrease flow. Which screws should be turned. How much to turn screws.

GROUP II (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
	set just as accurately as possible before securing the O. K.).	
36. Checking for Proper Color of Ink. Compare trial impression with proof for shade and depth of color. Compare trial impression (new color on previous colors) with proof. The good pressman picks out and compares specific points on the two sheets, e.g., the pupil of the eye, the lips, the finger nails, etc., of a figure. It is necessary to know that some inks change color slightly as they dry, e.g., reds, milori blues, and grays.	This is comparatively easy though none the less necessary if but one color is being printed. Extreme care must be taken that the color on each run may be satisfactory; otherwise the cumulative effect as other colors are added will not meet requirements. Expertness is necessary on high-class jobs for detecting the fine points in color effect.	What effect drying will have on the color being printed. The kinds or types of defects to look for and how to detect them. The evidences of satisfactory character to be looked for and how to detect them.
37. Checking for Proper General Effect. Compare trial impression carrying all colors to date with proof sheet, looking this time for general effect, how well the combination of colors matches the proof in every part of the design, etc.	The slightest defect in finish due to improper consistency of ink is sure to result in trouble later on. A soft, rather than a hard, appearance is essential to securing proper color effects.	How to compare printed sheet with proof and definitely locate points of similarity and difference. How to estimate the effect that the present finish will have eventually.
38. Adjusting Front or "Gripper" Guides (Also Called "Stop-Guides") on Automatic or Hand-Fed Press (See No. 12). This is necessary only when guides are improperly set. Loosen guides. Place pieces of paper of same thickness between each guide and its slide.	See operation No. 12.	Which way to shift in order to correct register. How to make adjustment.

GROUP II (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
Tighten guides until the pieces of paper have the same "feel" when removed.		
39. Checking Impression for Proper Register. Compare marks on sheet made by new plate with those already printed from previous plate or plates. (Care must be taken to compare marks on all parts of sheet including the extra side (edge) mark, etc., in case pressman placed such extra marks on plate. Where solids are being printed, it is advisable also to see if they are falling right on colors already on sheet. Sometimes register marks tally, yet colors do not register correctly. In such cases, usually the plate or paper is at fault. Occasionally a poor transfer is responsible.	If the new impression (where more than one is required on the same sheet) does not fit exactly over or on the last one, the effect is naturally unsatisfactory. The pressman must secure utmost accuracy of register.	What constitutes accurate register on different kinds of work. How to detect evidences of inaccurate register.
40. Running Trial Impression Sheets for Checking the "Lay." Throw damping lever on. Throw impression lever on. Run several used sheets (from 6 to 10) through press. Run blank sheet (one of same kind and color as to be used for run) through. If testing for second impression on several-color job, run through one or two sheets of pile to be printed. In case ink, registration, etc., are not O. K. and another trial impression is necessary, the order of indicated procedure is re-	Trial impressions are taken for three reasons: To see if registration is accurate; To see if color effect (shade of ink and combination of ink on new run with that already on sheet) is satisfactory, that is, matches the proof; To see if general effect of ink mixtures on the sheet is satisfactory, whether too hard or too sharp, etc.	The procedure necessary for securing proper "lay." How to proceed. Necessity for being economical in the use of paper.

GROUP II (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
peated as many times as necessary.	(By doing this, the pressman is able to get all adjustments made before starting on the run.)	
41. Adjusting Plate on Cylinder.		
Loosen set screws on clamps on back end of plate, if to be shifted forward, and vice versa. Tighten, as needed, the set screws on other end of plate. (On certain makes of presses a special device for adjusting the relation of the cylinder surface to the drive wheel makes unnecessary the adjusting of the plate on the cylinder.) Care must be exercised not to loosen plate too far at one point and thus cause it to buckle. It must be loosened all the way along.	There are occasions when it is necessary to shift only one side of the plate on the cylinder. The register in such cases is accurate on one side of sheet but inaccurate on the other. No matter how carefully plates are marked it is impossible to get them on the cylinder so that they do not register "short" sometimes and "long" other times. The plate is shifted backwards or forwards on cylinder to correct the register.	What tools are needed. How to use necessary tools. In which direction to shift plate. What care to exercise and how to exercise it.
42. Adjusting Plate Cylinder.		
Loosen set screw or screws (some presses have one screw only, while others have several). Shift drive wheel as required. Tighten set screw or screws.	A device on the drive wheel of the plate cylinder may be shifted so as to change the relation of the cylinder to the drive wheel. The object is to shift the plate and thus affect the register.	Amount and direction of adjustment needed. Tools required. How to make necessary adjustment. Necessity of exercising care so that adjustment may not be overdone.

GROUP III

Operations Chiefly Connected with Tending the Press During the Run

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
43. Stirring Ink in Fountain and Pushing It Up Against Roller. This is usually performed with the broad knife. The blade of the knife is forced semi-broadside (angle of 45 degrees) through the ink. This not only stirs the ink but pushes it up against the fountain roller.	The fountain roller always pulls down on the ink. This causes ink to pull away from the roller and thus touch the roller increasingly less. In order that fountain roller may carry enough ink to the inking rollers, it is necessary to push the ink up against it from time to time. Ink is stirred occasionally to overcome its tendency to become stiff and not flow readily. This tendency is much more marked in some ink mixtures than in others. It is good practice to draw the knife along the edge of blade to release foreign particles that may have accumulated.	Must know what broad knife is and how to use same for purpose intended. Must know when ink is not up against fountain roller as it should be; also when ink is of such consistency that occasional stirring is necessary. The pressman can easily tell by the lighter appearance of the print on certain spots when the ink is not up against the roller. Before he can be absolutely sure that the ink is the cause, he must know that the water is O. K. and that the dampers are doing their work right.
44. Cleaning Sand or Grit Off Form Rollers. Locate grit or sand on roller. (The mark of the grit on the printed sheet makes location easy.) Scrape grit off roller with knife. If grit is imbedded in roller, as sometimes happens, it may be necessary to pick or dig same out, or to remove the roller entirely and scrape all parts of its surface.	In spite of the precaution taken in all first-class pressrooms, once in a while sand or other gritty substances get on the rollers. If not removed they scratch the plate and sooner or later affect the quality of printing.	How to detect evidence of sand or grit on rollers. How to remove same from rollers. Realize necessity of doing job well.

GROUP III (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
45. Patching the Blanket. Locate depression in blanket. Mark outline of depression on back of blanket with piece of chalk. Cut piece of paper to fit. Paste paper to blanket at point of depression. Add other pieces as needed, being careful that no wrinkles are left in any of the papers. It is necessary to use a paste that dries flat. Thin paper is always necessary as is also tearing of the paper so that the edge is graduated off.	All blankets eventually break down or wear out. Very often the breaking down will appear first in small spots only. This blanket weakness shows up in the printed sheet in the form of spots where there is little or no ink. The patching is for the purpose of building up the blanket surface at points of depression to make the surface perfectly cylindrical once more and thus insure its receiving and passing on a perfect impression.	How to locate defective spot. How to build up blanket at such point or points. What tools and materials are needed and how to use them. Necessity for perfect blanket surface.
46. Reducing Ink on Rollers by (*a*) Running Sheets Through Rollers; (*b*) Scraping Ink Off Drum Roller. Hold end of broad knife blade (have handle end down) firmly against surface of drum roller at point where ink is too heavy. Repeat as necessary until amount of ink is sufficiently reduced. It is possible to remove part of ink without taking rollers off. Care must be taken that the sheets do not go in the wrong direction and injure either the blanket or the plate.	It is not unusual for the pressman to get the rollers slightly overcharged at one or more points. If this happens and he desires to reduce the ink at that point without taking it all off, this may be done by running sheets through. In addition to, or instead of, as the case may be (for some pressmen do one way and others the other), reducing the amount of ink by running sheets through, certain pressmen reduce it by scrap-	How to place sheets in the rollers. How to guard against injury to the plate or blanket. How to hold knife to accomplish the purpose. How to guard against possible injury. Where scraping should be done.

GROUP III (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
	ing the drum at the point directly opposite. This can be done without stopping the press, though one runs a risk of injury by doing so.	
47. Removing Foreign Substance (Small Bit of Wood or Paper) from Surface of Blanket.		
Locate cause of trouble. Remove by pushing end of knife blade underneath and prying substance out, or pull out with the fingers. Care must be exercised lest surface of blanket be broken by the knife blade. Some maintain that if the brush is properly set, foreign substances will not get to the blanket. A good wash will sometimes effect a cure.	Foreign substances of any character on the blanket surface are responsible for either one or both of the following: (*a*) Prevent blanket from printing at that spot. (*b*) If hard, they injure the plate in a very short time. The surface of the blanket may also become injured in a short time.	How to locate cause of trouble. How to remove it without injuring the blanket.
48. Changing Consistency of Water Mixture.		
If it is too strong or contains too much acid, add more clear water. If too weak or contains too little acid, add more acid. It is always advisable to use a minimum of "dope" in the water. There should be no guessing about this matter.	If water is too strong it will "kill" the work or design sooner or later. If water is too weak it will fail to keep plate from taking ink and printing where it should not.	When water is too strong or too weak. How much acid and how much new water to add in each case.
49. Placing Additional Water in Fountain.		
This is merely a matter of pouring water from a pail or can into the fountain.	A certain amount of water must be kept in order that the roller	How much to pour in and how to pour it.

GROUP III (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
It must be done in such a way that none is spilled.	may carry sufficient water to the dampers, and they, in turn, to the surface of the plate.	
50. Mending Surface of Blanket.		
Fill hole with rubber cement, using the point of knife blade to press cement into hole. Allow same to dry. Rub down smooth. Cover with powder. Some place a small patch of mending tissue on rubber cement before putting powder on.	Unless the blanket surface is perfectly regular and smooth, it does not receive ink from the plate and transmit it to the sheet as it should. Depressions or breaks of all sorts must be immediately overcome by the pressman.	Kind and quantity of cement to use. How to perform the operation. The tools needed and how to use them.
51. Adjusting Dampers During Run.		
This is merely a matter of loosening or tightening the devices which control the damper rollers and damper ductor. The mechanism varies somewhat on different presses but in all cases the adjustment can be easily made.	The pressman sometimes finds that he must have more water, or it may be, less water, for his printing. If his fountain contains the right amount of water, he meets the need by adjusting the damper controls.	How much to shift dampers. How to make necessary shifts. Tools needed and how to use them.
52. Gumming Plate During the Run.		
Rub surface of plate with sponge saturated with gum arabic solution. Rub plate surface with soft, damp rag. (Some pressmen always go over the plate twice, both with the rag and sponge.) In all instances the plate must be fanned dry after the gum is spread out even.	If the surface of the plate were not protected by the thin film of gum it would oxidize. The plate would then take ink at these exposed points and print where it should not. Notwithstanding the arrangement whereby a slight amount of gum (acid) is being distributed over the plate con-	How to use the rag and sponge. How much gum solution to have on sponge when performing the operation. The necessity of preventing the gum from getting on the blanket. How to use sponge and rag properly.

GROUP III (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
	stantly by the dampers, it is advisable to re-gum the plate. This is particularly necessary if the press is not running steadily. The soft rag is to insure that gum is evenly distributed over the plate's surface; to make sure that no undue amount is left at one spot to cut into the design a few minutes later.	
53. Powdering Blanket. Spread sulphur and soapstone mixture over surface with powder bag. Spread out evenly on the blanket by means of dry rag.	Unless blanket is powdered after being cleaned, the sheet sticks to it. It is claimed also that the life of the blanket is lengthened if it is kept powdered.	Materials needed and how to use them. Necessity for covering entire surface of blanket.
54. Cleaning Blanket. Rub with soft rag soaked in good turpentine. (Some always wash with clean water first; others wash with water only when lint has accumulated.) If turpentine is used to cut ink, then the surface of the blanket should be vigorously washed at once with benzine or gasoline. Immediately rub washed portion with clean dry rag, until all portions of blanket are clean.	The blanket slowly collects ink and lint. If these are not removed, the printed sheet soon looks dirty or muddy because the ink piles up or specks where the lint has collected in any amount on the blanket.	What tools and materials are needed. How clean blanket needs to be. How to use tools and materials so as to get a clean blanket surface.
55. Tending Press During Run. The number of different things done by pressmen when tending the press	Lithographic printing is rather delicate work. In order to turn	How to recognize every known type of lithographing defect

GROUP III (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
during the run is large; those frequently done is small. The most common are: Check printed sheet for color effect. Check printed sheet for amount of ink on sheet. Check printed sheet for evidence of defects. Adjust fountain feed. Adjust dampers. Adjust inking rollers. Adjust automatic feeder. Stir ink in fountain and push ink up against fountain roller. Keep blanket cleaned and powdered. Wash and gum the plate. Keep ink and water fountains supplied. It is necessary to keep careful watch of back of next sheet in order that offsetting may not develop.	out a good product the pressman has to be on the alert constantly. This is necessary because, even though the press has been adjusted in every way to the needs of the run, there are many things that may go wrong. Thus, no more water than is absolutely needed should ever be used. But when using much ink the amount of water must also be greater. The flow of ink must also be carefully watched.	and the possible cause or causes of each type. How to remove each type of defect. What parts of the printing mechanisms, operations, etc., to watch most closely. How to compare in detail the printed sheet with the proof.
56. Etching Portion of Design on Plate. Rub defective portion of design with cotton dipped in acid. Wash the rubbed spot with wet rag. Cover with weak gum arabic solution. (Sometimes two or three etchings are required to get the necessary effect. The pressman prefers repeating the operations to overdoing the etching the first time.) Sometimes powdered resin is placed upon the plate.	Occasionally the pressman finds that his plate prints too heavy or too deep at a certain point. Upon examination he finds that the design is very full at this place, or in other words, that it is not thin enough. He "thins it out" by what is known as etching and thus cuts down its "depth-producing" qualities.	Materials needed and how to use them to perform operation satisfactorily. Necessity for being careful not to overdo the etching.

GROUP III (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
57. Polishing Out Parts of Design. Rub spot which is to be polished with wet sponge. Polish with snakestone. Follow up with sponge. Repeat until spot has been polished entirely out of plate. Cover spot with acid solution. Gum up and fan dry. It is necessary to do this carefully. Scumming is always more likely at the points polished.	Occasionally the plate is developed or inked up where it should not have been. The pressman discovers this when he examines the printed sheet. If the mistake is a small one, he polishes the design out or off; otherwise the plate must be taken off press and returned to the transfer room. The purpose is to get the plate to print only where it should.	Materials needed and how to use them to perform operation. Necessity for not overdoing polishing. How to put plate in shape after polishing is completed.

GROUP IV

Operations Not Included in Any of the Other Groups

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
58. Setting Damper Ductor. The important thing is to have the ductor set so that on each revolution it establishes definite and complete contact with the brass roller on one side and the fountain roller on the other. While the mechanism governing the setting is not hard to understand, it is impossible without graphic aids to make clear how to do it.	The purpose of the damper ductor cannot be realized unless it is set properly. If for any reason, therefore, the adjustment is changed, it must be reset properly.	Tools and materials needed. How hard ductor should strike other rollers. How to adjust mechanism which controls the ductor. Necessity for setting ductor control properly.
59. Getting Press Ready for Run in Morning. Take oil sheets off ink fountain. Run old sheets through ink rollers to get oil off. Soak dampers with water. Put dampers back on press. (Some pressmen do not remove dampers at night.) Ink rollers until correct amount is on for printing. Dampen plate properly. Run several spoiled sheets through press. Many pressmen always remove quick-drying inks from fountain at night.	Oil must be taken off ink rollers so that printed sheet and design will not look greasy and smeared. If dampers have been removed they must be put back on press and dampened so that when press is started they will dampen plate properly; if on press, then damping only is necessary. Press is run for a few minutes so as to get dampers soaked and ink rollers free from oil.	Condition in which rollers and dampers and fountain must be before starting to print. What to do in order to get rollers, fountain, and dampers in proper condition. How to get the job done. Necessity for thoroughness.
60. Setting Top Dampers. Loosen device which holds damper in place. Put piece of paper (.003) between each end of top damper and plate. Adjust so that paper can barely be removed.	In order that the top damper may do its full part in transmitting water to the plate.	Tools and materials needed and how to use them. The "feel" necessary for proper setting of damper.

GROUP IV (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
Tighten devices holding damper in place.		How to adjust devices.
61. Setting Bottom Dampers.		
Loosen device which holds damper in place. Put piece of paper (.003) between each end of bottom damper and the plate. Do likewise with brass roller and bottom dampers. Adjust so that paper may barely be removed. Tighten devices holding damper in place.	In order that the bottom damper may do its work properly.	Same as in No. 60.
62. Cleaning Surface of Plate Cylinder.		
Scour with rag and gasoline. Clean with soft dry rag. Cover with thin film of machine oil.	To remove any substances that might later cause irregularity in surface of plate. To prevent water on surface of cylinder from causing rust.	Necessity for careful but thorough treatment so that surface may not become scratched in any way. Materials needed for operation. How to do the work.
63. Cleaning Cylinder Bearers.		
Rub with rag and pumice stone until thoroughly clean. Wipe off with clean, dry rag. (Be careful that no pumice stone gets into the gearing.)	The bearers on the ends of the two cylinders which form contact are necessarily very close together (from .003 to .005 inches). Unless the pressman is careful to clean the bearers every few days they collect dirt, ink, etc., which in turn interfere with the pressure.	Appreciation of need for thoroughness. Necessity for utmost cleanliness. Materials needed and how to use them to perform necessary work.
64. Cleaning Skeleton Wheels.		
Rub surface of wheel which touches sheets with rag soaked in gasoline.	Since every printed sheet not only comes in contact with but	Necessity for utmost cleanliness in this connection.

GROUP IV (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
In case gum has accumulated, use water. Remove all dust on other parts of wheels by means of benzine rag.	passes under the skeleton wheels, and since utmost cleanliness is essential to good printing, the wheels need to be cleaned every few days.	Materials needed and how to use them in performing the operation.
65. Cleaning Surface of Blanket Cylinder.		
Rub thoroughly with soft rag soaked in kerosene (benzine or benzol are also used). Rub with dry rag. Cover with light film of machine oil.	A perfect surface is essential to good printing. It is necessary, therefore, not only to keep the cylinder surface clean but also to keep it from rusting.	Necessity for removing evidences of rust and of being thorough. Tools and materials needed. How to use tools. Materials to accomplish purpose.
66. Cleaning Gripper Posts.		
Throw grippers up. Wash parts of posts which contact with grippers with rag soaked in benzol. Wipe with dry rag.	If dirt collects on posts it is impossible for grippers to lock down as they should.	Materials needed. How to use materials. How to perform operations.
67. Rubbing Long Crease or Furrow Out of Blanket.		
Rub parts of blanket on each side of the crease with emery paper and wash with turpentine until furrow disappears.	If this unevenness were not removed from the blanket it would appear in the form of a scar on the printed copy where little or no ink had been distributed.	Location of furrow or crease. Tools and materials needed and how to use them to perform operation. Necessity for care lest operation be carried too far.
68. Timing the Side Guides.		
These guides are regulated by a cam. Loosen set screws on cam. Turn cam forward if guides should raise or move more quickly; backward, if they should raise less quickly. Tighten set screws.	Presses are constructed so that the sheet must enter at a definite moment if it is to receive the impression at the right time and place. It is essential that the guides synchronize perfectly	Construction and function of the cam mechanism. How to adjust cam mechanism so as to quicken or slow up the guides. Tools needed and how to use them.

GROUP IV (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
	with the rest of the machinery. The cam when set properly accomplishes this purpose.	
69. Cleaning Automatic Devices. Rub thoroughly with rag saturated in benzine.	This is done in order that the devices may function properly and not dirty the sheet.	Necessity for thoroughness. How to perform operation. Tools and materials needed.
70. Removing Glazed Surface from Composition Roller. Rub vigorously with rag soaked in alcohol. (Some recommend the use of varnish remover.)	After being used for a time the surface of the roller becomes glazed or covered with a hard coat of ink. Since this causes the roller to distribute poorly it must be removed.	Necessity for thoroughness. Materials needed. How to perform the operation.
71. Gumming Plate When Press Is to Stand Idle for Some Time. The same procedure as in No. 52 with this addition: Fan surface of plate until dry, this operation to be performed immediately after the gum has been evened out by means of the rag.	The fanning is to insure rapid drying. If the gum is allowed to dry slowly on the plate it may crack and thus leave the surface exposed to the ink when the press starts.	How to use the fan. The necessity for immediate use of the fan.
72. Cleaning Water Pail and Sponges. This is purely a matter of plenty of hot water with occasional use of the scrub brush. The sponges should be cleaned daily. The pail may be cleaned less frequently. It is usually washed out each morning.	Dirty water and dirty sponges are sure to cause printing difficulties.	Necessity for thoroughness. How to perform operation. Materials needed for work.

GROUP IV (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
73. Cleaning Water Fountain.		
Remove water from fountain with sponge, or remove fountain and pour water out. Wash fountain as clean as possible with sponge. Polish brass roller with pumice stone solution and rag. (Some recommend that thin film of gum be placed on roller.)	This is done so that dirt which collects on surface of water may not be transmitted by water dampers to surface of plate. That solution may not become sour and affect the quality of printing.	How to get water out of fountain and to clean fountain thoroughly. How to clean brass roller.
74. Getting Fresh Gum Solution.		
One of the most frequently used substances in lithographic presswork is gum arabic solution. Because of this fact it is always kept at hand in a bottle or some kind of porcelain vessel. If the solution is not kept fresh it does not perform its work.	Sour gum is damaging to the plate, especially the inked portions; therefore the necessity of using only fresh gum. In warm weather, fresh gum must be provided each day.	Location of fresh supply. How to clean receptacle thoroughly.
75. Sulphiding or Hardening Surface of Blanket.		
Clean blanket thoroughly with rag soaked in carbon disulphide solution. Follow with dry rag.	The necessity for reducing the "tackiness" or yielding quality of blanket is sometimes very pressing. In other words the surface must be made harder so that it will print well on coated paper.	
76. Reviving Blanket.		
Rub surface with very finest grade of sandpaper. (Some use pumice stone.) Clean thoroughly with rag soaked in benzol.	The surface of the blanket sometimes hardens, that is, loses its resilient quality after being used. It is necessary to remove the hardened layer before the resiliency will return.	Tools and materials needed. How to use tools and materials to perform operation.

GROUP IV (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
77. Preparing Plate for Storeroom. Gum thoroughly. Spread gum out evenly and fan dry. Wash carefully with asphaltum (tincture solution).	So that the surface of the plate may be preserved for further use. The gum puts a film on the plate and the tincture removes all possible dirt. It is important that this be done thoroughly, otherwise the plate will deteriorate.	Materials needed and how to use them. Necessity for doing the work thoroughly.
78. Setting the Delivery-Grippers. Care must be taken when performing this operation not to lose the opening of the grippers. On presses which use individual gripper pads, the procedure should be: (*a*) Place strip of .0015 thickness under stop; (*b*) Open up all grippers; (*c*) See that feeler gauge is tight; (*d*) Set individual grippers, one at a time, lightly on gripper pad starting from center and working out to ends. Where There Is a Stop on Gripper Rod: (*a*) Place piece of paper .005 thickness under stop on gripper rod; (*b*) Set each gripper so that stock to be run pulls evenly from all points.	Unless all grippers are set almost alike, delivery trouble may occur. The pressman rarely ever has any trouble of this kind, in fact, only when a gripper works loose, etc.	Tools and materials needed and how to use them properly. The "feel" which indicates that grip is all right

GROUP IV (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
Where there is no stop on gripper rod, the procedure is: (*a*) Loosen all but two end grippers; (*b*) Place piece of paper under one of end grippers; (*c*) Place thickness of paper (necessary for even pull) under the other end gripper; (*d*) See that the pull is even on the two pieces; (*e*) Set the remaining grippers in the same way and tighten. On the spring type of gripper, the block which lifts each gripper should have an even clearance of .010 inches if the spring is to do its work properly.		
79. Tightening Bolts and Screws on Press. It is inadvisable to attempt to detail the procedure in this instance. The apprentice may "bark" his hands a few times before he becomes accustomed to using a wrench properly but that, in most instances, cannot be avoided. The important thing is that he may realize that the press cannot run properly if bolts and screws are loose.	Regardless of the kind of machine being used, bolts and screws —particularly on new machines—are likely to work loose. Unless they are kept tight, not only will the machine fail to do good work but it will go to pieces much sooner.	Where various bolts and screws are located. What tools are needed. How to use the tools to accomplish the purpose. Realization of necessity of thoroughness.
80. Putting Blanket on Cylinder. Place anchor bars in notches on cylinder. Revolve cylinder holding	Offset press blankets are indispensable to printing. Regardless	Tools needed and how to use them. Necessity for care in

GROUP IV (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
blanket close against cylinder surface. Insert other end of blanket in clamps. Tighten clamps evenly. Tighten blanket. Push ratchet in place which holds blanket (on certain presses only).	of how carefully they are used, they must be replaced every few weeks.	using power to revolve cylinder. How to handle operating mechanism which holds blanket tight on cylinder. How tight to pull blanket.
81. Getting New Blanket Ready for Press. Place blanket flat on floor with printing surface up. "Square up" blanket with try-square and place guide marks on all corners. (In many plants the blanket is "squared up" before the pressman gets it.) Place straight-edge on corner marks at end on which anchor bars are to be placed and draw line across blanket. Place top anchor bar on blanket so that edge falls exactly on the line. With pencil, mark the places where bar holes are to be made in blanket. Remove bar and punch holes in blanket. Put blanket between anchor bars and clamp together with screws. Tighten screws. (On some presses a pair of bars is clamped on the other end of blanket before it is put on the cylinder.)	This is done because the old blanket does not do its work well. It is essential that blanket be mounted properly upon clamp bar before it can be put upon cylinder.	Tools needed for doing work properly. How to use tools. Necessity for being careful.
82. Cleaning Surface of Impression Cylinder. Polish the surface of cylinder with rag and gasoline. Follow up first with rag saturated in kerosene, then with dry rag.	If surface of impression cylinder is not kept clean, it will have a bad effect upon pressure and thus make	Materials needed. How to use materials to accomplish purpose. Necessity of being

GROUP IV (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
	good work impossible.	careful not to rub surface too hard with pumice stone if it is used.
83. Taking Ink Fountain Apart.		
While this is done only occasionally it must be done or printing troubles will be sure to result. The bolts and screws that must be loosened in order to get the fountain apart are plainly visible. Accordingly, no statement regarding the same is necessary. On at least one make of press, the fountain may be thrown away from fountain roller, thus making it possible to clean quickly and easily.	Occasionally, dependent upon the kind and quality of ink used, it is necessary to take the fountain apart so that anything which prevents easy and regular flow of ink may be removed.	Tools necessary and how to use them. Necessity for thoroughness and care. How to take fountain apart. How to assemble fountain properly.
84. Removing Blanket.		
With large cylinder wrench, turn cylinder until it is possible to pull out the ratchet which holds blanket tight. Pull ratchet out. Loosen clamps which hold the blanket. Pull end of blanket out and hold away from cylinder. Put on power and revolve cylinder until other end of blanket may be easily reached and blanket taken from press.	Blankets are removed when it is necessary to patch them on under side, when they need to be built up, i.e., have more "packer" put under them, and when they have lost their resiliency to such an extent as to be useless.	Tools needed and how to use them. How mechanism works which holds blanket tight. Necessity for care in using electric power while taking blanket off.
85. Getting Press Ready for the Night.		
Gum the plate (See Operation No. 52) and rub down with damp cheese cloth.	The only way to keep dampers round is to prevent them from	Effect that will be produced if steps indicated are not taken.

GROUP IV (*Continued*)

Name of Operation and How Done	*Why Done*	*Knowledge Necessary*
Wash out with asphaltum solution. (If work or design happens to be fairly strong, the asphaltum wash might well be omitted.) Clean the blanket. (See Operation No. 54.) Take dampers out and place on rack. (Some pressmen do not do this.) Put oil sheets (paper covered with machine oil) over the ink fountain. Scatter small amount of machine oil over the ink rollers. ("No wash up" is used by some.) Run press a few moments to distribute oil on rollers.	resting against anything for any length of time. It is to this end that dampers are taken off the press and placed on the rack. Ink has a tendency to harden if exposed to air very long. The oil film or "no wash up" solution on the ink rollers and the fountain counteract the effect of the air on ink. The blanket is washed so that the ink may not harden on it and cause trouble later. The plate is gummed to prevent air from striking it and it is fanned dry so that bubbles of air may not form under film of gum, break later on, expose spots on plate to air and allow oxidation to take place.	Tools and materials needed and how to use them in doing the necessary work. Necessity for exercising care.

B. Lithographing Defects, With Their Respective Causes and Remedies

As already stated, one of the techniques had for its objective the listing of all defects that appear on sheets which have passed through the press, and finding the cause or causes of these defects, and the respective remedies therefor. The results of this important and unique phase of the analysis appear on pages 57 to 66, under the following headings: Nature of Defect, Cause or Causes, and Remedies.[2]

[2] This procedure is in agreement with that followed by Charters and others, and is now considered one of the acceptable ways of locating desirable instructional content. (See *Twenty-Sixth Year Book*, Part I, pp. 365–79, for article on "Review and Critique of Curriculum-Making for the Vocations," by W. W. Charters.)

LITHOGRAPHING DEFECTS

Nature of Defect	*Cause or Causes*	*Remedies*
1. Printed design registers:		
(*a*) On left side of register marks on sheet;	Side guides need resetting.	Move side guides forward as needed.
(*b*) On right side of register marks on sheet.	Side guides need resetting.	Move side guides backward as needed.
2. Printed design is faint, the faintness extending evenly throughout the entire sheet.	The ink rollers are undercharged. Too much water may cause this trouble.	Open up feed screws on fountain as needed or add another tooth on ratchet which controls movement of fountain roller.
3. The printed design looks all right except in certain spots which present a "muddy" or unclear appearance.	Due to slight depressions either in the blanket or the plate, but usually the former, ink has "piled up" on the surface of the blanket and has been passed on in too large amounts to the sheet.	Clean the blanket thoroughly at the spot or spots where the ink has accumulated. Usually an occasional cleaning will enable the pressman to "get by"; but if he is working on a high-class job and has quite a run to make he removes the blanket and puts in "packer" as needed.
	Too much pressure may be responsible for this sort of trouble.	Correct the pressure.
	Too stiff ink may also be a factor in this kind of trouble.	Thin the ink so that it has less "tack."
4. Printed design registers:		
(*a*) "Long" or prints beyond all register marks on sheet;	Plate has not been adjusted on cylinder as it should be.	Shift plate forward for less "gripper." (Gripper guides may be readjusted to accomplish same purpose but this is considered poor practice.) Shift plate cylinder forward on presses which have this improvement.
(*b*) "Short" or prints under all register marks.	Plate has not been adjusted on cylinder as it should be.	Shift plate backward for more gripper. Shift plate cylinder backward on some presses.

LITHOGRAPHING DEFECTS (*Continued*)

Nature of Defect	*Cause or Causes*	*Remedies*
	Plate cylinder not adjusted properly.	Adjust plate cylinder.
	The pressure bars need adjusting.	Adjust pressure bars.
	Stop guides are out of line.	Line up stop guides.
	Diameters of plate and blanket cylinders are not the same when press is producing.	See that diameters of two cylinders are the same.
5. Printing uneven in areas of varying size.	(*a*) Irregular or untrue surface on cylinder, provided it is really a cylinder trouble.	Have cylinder reground if necessary. See that there are no particles of dirt, sand, etc., clinging to cylinder surface.
	(*b*) The blanket may have become glazed.	Wash thoroughly with benzine after opening up surface by rubbing with emery paper and pumice stone.
	(*c*) Variations in thickness of blanket.	Locate depression spots in blanket and build them up on bottom side by using tissue paper as needed.
	(*d*) Blanket has become pitted.	Clean, fill with rubber cement, and cover with powder after 3 or 4 minutes.
	(*e*) Variations in thickness of plate.	Build up plate in manner indicated for blanket.
	(*f*) Variations in thickness of sheet.	Increase the pressure.
6. Printed design registers accurately on one side of sheet but not on the other.	Slide on the side which registers inaccurately needs adjusting. (True on certain presses only.)	Re-set slide so that it is directly under the front or gripper guide.
7. Printed design shows that fine lines are becoming weak—are "fading out."	(*a*) Fountain water contains too much acid — is "killing" the design on plate.	Weaken the water by adding more pure water.
	(*b*) Untrueness in cylinder surfaces is causing "rubbing" of design.	Build up blanket or plate until cylinder surfaces are perfectly true or regular.

LITHOGRAPHING DEFECTS (*Continued*)

Nature of Defect	*Cause or Causes*	*Remedies*
	(*c*) Mica on the paper will cause this to happen after a time.	
8. Printed design is faint and uneven, i.e., ink is heavier in some spots than in others throughout the entire sheet.	Insufficient amount of pressure.	The remedy to employ varies with the type of press. On some presses the only thing necessary is to tighten the pressure screw at one end of the impression cylinder; while on other presses, pressure screws at each end must be tightened. Still another method employed is that of putting additional "packer" on the cylinder.
9. Color prints O.K. on gripper side of sheet but "short" on other side.	Paper has stretched since last printing.	If "rush" order, place "packer" on impression cylinder to increase circumference slightly; otherwise send paper to drying room. The pressman may take a certain amount of "packer" from the plate cylinder and put it under the blanket, then reduce the pressure on impression cylinder an equal amount.
	Pressure bars not adjusted correctly.	Adjust the pressure bars.
	Faulty transfer.	Secure new transfer.
10. Printed design looks "blotchy"—there may be one or more spots where no ink is being transferred to the sheet.	(*a*) Rollers on feeder are pulling up surface of sheet.	Relieve pressure of rollers on sheet. Softening the ink will help sometimes.
	(*b*) Poor quality of paper is shedding lint which is collecting on the blanket.	If on first-class job the pressman has a constant fight on his hands to keep blanket free from lint, all he can do is to pick or wash the lint off the blanket.
	(*c*) Feeder brushes may be scratching surface of sheet.	Readjust feeder brushes as needed.
		Always carry minimum of pressure, especially when paper is linty.

LITHOGRAPHING DEFECTS (*Continued*)

Nature of Defect	*Cause or Causes*	*Remedies*
	(*d*) Surface of blanket has become "pitted."	Fill pits with "Jiffy" or other suitable cement, wash down surface carefully, and cover with powder.
	(*e*) Surface of blanket has become glazed in spots so that it does not take ink properly.	Open up blanket by rubbing with fine sand paper and pumice stone, then wash with benzol.
11. Printed design cannot be made to match proof for certain color though this has not happened with previous colors.	(*a*) Shade of ink is too weak or pale—has not sufficient body or depth. Overcharged rollers make ink look too strong.	Use same shade of ink but put more body in it.
	(*b*) Shade of ink is too strong.	Use same shade but with less body or depth.
	(*c*) The plate may be different from the proof.	Ask for new plate after reporting to foreman.
12. Printed design is not sharp enough—details are covered up or clouded over in certain spots.	(*a*) Ink may be of wrong consistency—is too greasy.	Increase the amount of heavy varnish. Some colors require more than others.
Ink does not stay where it is supposed to.	(*b*) Plate may be wearing out—losing details in spots.	Sharpen plate at points of weakness by rubbing with etching solution.
	(*c*) Insufficient amount of acid in water.	Strengthen the water.
	(*d*) If a zinc plate, it may contain impure spots which are causing the trouble.	
	(*e*) Unevenness in gauge of blanket or plate is causing "rubbing" to take place.	Even up the surface of the blanket or plate as necessary.
	(*f*) Uneven damping.	Reset dampers in case they are still in good working condition; otherwise put on new ones.

LITHOGRAPHING DEFECTS (*Continued*)

Nature of Defect	*Cause or Causes*	*Remedies*
	(*g*) Transfer may be a poor one.	Report to foreman before asking for new transfer.
	(*h*) Ink rollers are set against the plate too firmly.	Reset rollers.
13. Printed sheet shows that the new color being run is printing where it should not.	(*a*) Dampers are not working as they should; they are not providing enough water at the point or points where the defect is appearing.	(*a*) Increase amount of water passing to the plate.
	(*b*) Brass fountain roller has collected some grease.	(*b*) Clean brass roller so as to remove all oil at point opposite where sheet is showing defect.
	(*c*) Damper has become greasy.	(*c*) Clean thoroughly.
	(*d*) Ink has become too greasy.	(*d*) Stiffen up the ink.
	(*e*) A transfer stain may be causing the trouble.	(*e*) Polish stain out with snakestone.
	(*f*) Ink may be washing or bleeding.	(*f*) May act all right if stiffened, but may require new batch.
	(*g*) Plate may have become oxidized.	(*g*) Secure new plate or polish spots out.
14. Printed design appears "heavy" throughout; lacks fineness of details.	(*a*) Ink rollers are overcharged.	Tighten feed screws on fountain.
	(*b*) Design on plate has "grown" or thickened.	Sometimes the remedy should be merely more water; other times, more acid needs to be put into the water.
		Gum the plate, roll it up, and etch; re-gum it and fan dry, taking care that plate does not remain dry for any length of time without gumming.
15. Printed design lacks what may be called general smooth-	This may be caused by a blanket which is too hard.	Soften the blanket.

LITHOGRAPHING DEFECTS (*Continued*)

Nature of Defect	*Cause or Causes*	*Remedies*
ness; it looks "hard" and "sharp" rather than smooth and soft.	It may also be due to ink which is too "stiff" or not well enough mixed.	Make the ink less "stiff" by adding thin varnish. Mix ink more thoroughly.
16. Printed design shows round-cylinder streaks, uneven distribution of ink, giving a streaky appearance from front to back of sheet.	Occasionally this may be due to dirty rollers. In clean pressrooms, however, this rarely happens.	Clean all dirt off rollers. The blanket had better be cleaned also.
	Uneven distribution of ink by rollers.	Reduce the amount of ink on overcharged portion of the rollers. Re-set rollers, if necessary.
	Ink rollers are not meshing evenly the full length.	In case a roller has become warped, put in a new one.
	Too much water in spots will do this.	Cut down water.
	Hardened ink gets between fountain blade and the roller and allows the ink to flow too freely at other points; the feed screws are set so that ink is not being passed to the rollers evenly.	Even up amount of ink already on rollers and set feed screws to distribute evenly.
17. Printed designing shows "blur" across the back end of the sheet.	The back end of sheet is buckling slightly between the cylinders.	Drop the cylinder brush down further, or employ any other means to cause the sheet to pass between the cylinders entirely straight.
	Blanket not tight enough.	Tighten blanket.
	Too much pressure.	Lighten the pressure.
18. Printed design lacks depth of color in certain places though O. K. elsewhere.	Design on plate is too "thin" in places.	This is a job for the transfer room. Pressmen will do well to keep hands off such defects. Allow such parts to remain exposed (without water) for few minutes.

LITHOGRAPHING DEFECTS (*Continued*)

Nature of Defect	*Cause or Causes*	*Remedies*
19. Printed design looks uneven, is weak, "pale," "blotchy," "washed out," "spotty" in appearance.		
(*a*) Work remains firm.	Ink is not of proper consistency — has become emulsified because of too much water.	Stiffen the ink so that it can effectively counteract water. Water may need to be cut down.
(*b*) Work is going to pieces.	Water contains too much "dope"—is getting into the work and killing it.	Weaken water.
20. Printed design has a faint streak running across it.	This is due to what is known as a "sheet wound" in the blanket surface and is caused by sheet going between the cylinders in crumpled form.	Rub furrow or scar out of blanket with some fine emery paper and pumice stone, then build up with tissue paper on bottom side as needed. Another method is: remove blanket and soak thoroughly with water that part directly underneath the spot where wound occurred. This causes blanket to swell and thus removes scar. Rub spot with rag soaked in turpentine. Dry off and powder.
21. Registers accurately in only certain sections of sheet.	(*a*) May be due to uneven surface on blanket but, if so, this is not register trouble.	Build up blanket surface.
	(*b*) May also be due to uneven tension exerted on sheet by impression cylinder grippers.	Re-set grippers so that same amount of pull is given to every part of sheet.
	(*c*) May be due to "stretchiness" of blanket.	Trim blanket so that it may be drawn tighter; otherwise secure a new blanket.

LITHOGRAPHING DEFECTS (*Continued*)

Nature of Defect	*Cause or Causes*	*Remedies*
	(*d*) Stops on impression cylinder may be out of line.	Square up stops.
	(*e*) May be due to worn bushings on cylinder gripper shaft.	Put in new bushings.
	(*f*) Gears on cylinders have become worn so that they yield (slip) slightly during some revolutions but not during others.	This is a job for the machinist.
22. Registers sometimes too far to the right and sometimes too far to the left but at varying distances.	Pressure bars are in need of adjustment. (These are not found on some presses.)	Raise or lower pressure bars as needed, as the trouble may be due to their being either too high or too low.
	Push type of side guide may not be entirely square with the sheet.	Square up side guide with the side of sheet.
23. Sheet wrinkles when going through the press.	Paper may not be seasoned properly.	Paper must be returned to drying room.
	Impression cylinder grippers may be exerting uneven tension on the sheet.	Re-set grippers.
	Cylinder brush is not set so as to exert even pressure on sheet.	Re-set cylinder brush.
24. A small streak of ink appears on the unprinted portion of sheet.	Some hard substance, possibly a piece of wood, has become imbedded in the blanket.	Remove before surface of plate is broken, takes ink and prints permanently.
		Polish spot with snakestone. Rub with etching solution. Gum up and fan dry.
25. Printed design registers "short" unequal amounts on front and back register marks.	Paper has shrunk.	If a short run, try placing a sheet of paper under the plate.

LITHOGRAPHING DEFECTS (*Continued*)

Nature of Defect	*Cause or Causes*	*Remedies*
26. Printed design shows general side-blurred appearance.	The cylinder bearings are worn so that they do not run exactly "plumb"; they shift a trifle sidewise occasionally.	If possible, take up slack in cylinder bearings.
27. Printed design shows what are commonly known as "roller marks," or badly blurred streaks, crosswise of sheet as it comes from the press.	This is caused by a "flat" on one of the rollers. In other words, one of the rollers has become out-of-round at one point with the result that when this part contacts with the plate it skids slightly.	Sometimes a slight rubbing with the fingers will remove the flatness; again it may be necessary to remove the roller and give it a thorough going-over, substituting a new one for the time being.
	Skin on leather-covered roller has become loose. Dirty or loose damper covers may be causing trouble.	Secure new cover. Clean or tighten covers as needed.
28. Printed design registers accurately part of time.	(*a*) Groove worn in side guide. (*b*) Depressions in gripper posts.	Remove guide and have groove ground out. Put in new posts.
29. Printed design shows a bar-like appearance, the bars being about an inch wide and an inch apart and running crosswise of the sheet as it comes from the press.	This is due to imperfect pressure and is known as "gear mark" trouble. Usually it is due to the fact that one cylinder has been built up or made larger than the one with which it meshes. Because of this the bearers cannot ride each other all the time as is intended.	Build up or "pack" cylinders evenly, i.e., so that each cylinder is exactly the same size as the other.
	Back leash gears are out of adjustment, thus permitting what is known as "back leash" to take place.	Tighten "back leash."
	Accumulation of dirt or oil on cylinder bearers.	Clean thoroughly.
	Split gear or segment on one of cylinders.	This is a job for the mechanic.

LITHOGRAPHING DEFECTS (*Continued*)

Nature of Defect	*Cause or Causes*	*Remedies*
30. Printed design looks too glossy or shiny.	The ink mixture contains too much "long" varnish.	Tone down by adding more ink, or mix new batch putting in less varnish.
31. Printed design is too flat in appearance, needs brightening.	The ink mixture does not carry enough varnish.	Add more "long" varnish for quick drying colors; "short" varnish for slow drying ones.

CHAPTER IV

VERIFYING THE ANALYSIS

A. Offset Press Operations and Lithographing Defects

It will be granted by any one acquainted with the technique of trade and job analysis that the investigation was prosecuted in accordance with the best known techniques. Before using the results as a basis for instructional material and a course of study, however, it was desired to prove their validity beyond any reasonable doubt. To this end the data on press operations and lithographing defects were codified and submitted to sixty-seven subscribers to the Foundation with the request that an employee, in whose judgment the management had great confidence, be asked to criticize them carefully. To this request twenty-one complied by sending one hundred twenty-four suggestions, eighty-nine of which related to press operations and thirty-five to lithographing defects. Though the agreement was high among these responses and the suggestions so distributed as to indicate that all parts of the analysis had been carefully reviewed,[1] it was desired to check further the accuracy of the various items. Consequently, they were arranged as indicated in Form 5, page 70, and submitted to pressroom foremen in eleven outstanding lithographing plants, with the request that each item be checked either affirmatively or negatively. A tabulation of the judgments of these eleven experts (Tables I and II) shows agreement to the extent of 95 per cent. The original analysis was then modified by adding those suggestions which had been unanimously approved.

A copy of the letter sent with the analysis to sixty-seven subscribers to the Foundation follows:

As the first step towards the preparation of text material for the training of offset press apprentices, we have made an analysis of the operations connected with offset presswork and the defects on the sheet which the offset pressman must be able to recognize and to correct.

[1] See Tables I and II (pp. 69 and 70).

We have secured this information from offset pressmen and pressroom foremen and want to be sure not only that we have included everything but also that our statements are all correct.

Will you therefore please select from among your pressmen one in whom you have confidence and upon whose judgment you can rely, ask him to go over this analysis carefully, and give us the benefit of his suggestions as to changes or additions?

In order that the greatest value may be gained from your criticism I am asking that you observe the following procedure:

In case you entirely approve of what is given regarding any one item, place an "O.K." on the right-hand margin of the page. In case you do not approve what is given in any instance, indicate your suggestion or correction either in connection with the item or operation or on a separate sheet with proper references so that no difficulty will arise in attaching corrections to the proper item.

In order that we may have our records complete, will you kindly have the person who checks this analysis sign the last page, indicating his official position in your organization.

We realize that compliance with this request means careful and painstaking work on the part of the man or men whom you select. However, it is the only way we know of pooling the knowledge and experience necessary for the preparation of authentic teaching material.

We will appreciate your coöperation in this matter.

The letter sent with codified suggestions to eleven pressroom foremen was as follows:

It is desired to secure an accuracy check on the several changes suggested in the analysis of the offset pressman's trade which was recently submitted to a large number of offset pressmen in different parts of the United States. To that end you, with several others, are requested to read the attached list of suggestions and place a check mark in the bracket at the right which represents your judgment; in the Y bracket if you agree, the N bracket if you disagree. In case you do not know, leave both brackets blank. If you will be kind enough to do this you will assist materially toward the preparation of the proposed basic text material for lithographic apprentices.

It might be well to mention in this connection that the investigator had previously coöperated with all of these foremen — in fact, had talked with several of them at length regarding the investigation and features closely associated therewith. That this relationship was in no small degree responsible for the unusually high number — 100 per cent — of responses seems highly probable. Moreover, the total number of these responses, as well as their nature, testifies to the value of personal contact when making investigations of this character.[2]

[2] See Form 5, pp. 70–81 and Table III, p. 87.

TABLE I

NUMBER AND DISTRIBUTION OF CORRECTIONS AND ADDITIONS RECEIVED (PRESS OPERATIONS) *

No. of the Operation in the Analysis	*Corrections*	*Additions*
1	1	..
2	..	1
3	3	..
4	1	1
5	..	2
6	2	4
7	2	1
8	..	1
9	..	..
10	..	1
11	..	1
12	2	1
13	1	2
14	1	5
15	2	1
16	..	1
17	..	7
18	1	..
19	1	1
20	..	..
21	2	1
22	..	3
23	1	1
24	..	2
25	..	5
26	..	1
27	1	..
28	..	..
29	..	8
30	..	..
31	..	..
32	..	1
33	..	..
34	..	..
35	..	..
36	..	1
37	..	..
38	..	..
39	..	1
40	1	..
41	..	1
42	..	..
43	..	..
44	..	1
45	2	1
46	..	..
47	1	1
48	..	3
49	..	..
50	2	..
51	..	..
52	..	2
53	..	..
54	1	1
55	..	1
56	..	1
57	..	2
58	..	..
59	1	..
60	..	..
61	..	..
62	3	1
63	1	..
64	..	..
65	..	..
66	..	..
67	..	..
68	..	..
69	..	..
70	..	..
71	..	..
72	..	..
73	..	1
74	..	..
75	..	1
76	1	..
77	..	..
78	..	13
79	..	..
80	..	1
81	1	1
82	..	1
83	..	..
84	..	..
85	..	2
Totals	35	89

* The term "corrections," as here used, refers to specific objections to statements made in the analysis, while the term "additions" refers to suggestions contained in the analysis which were in the nature of elaborations and not in any respect contradictory to statements occurring in the analysis.

TABLE II

NUMBER AND DISTRIBUTION OF CORRECTIONS AND ADDITIONS RECEIVED (LITHOGRAPHING DEFECTS)

No. of the Defect	*Corrections*	*Additions*	*No. of the Defect*	*Corrections*	*Additions*
1	None	..	17	None	2
2		2	18		2
3		1	19		1
4		4	20		..
5		3	21		1
6		..	22		1
7		1	23		..
8		..	24		..
9		2	25		..
10		3	26		..
11		..	27		2
12		1	28		..
13		6	29		3
14		..	30		..
15		..	31		..
16		..			—
			Totals		35

FORM 5

SUGGESTED CORRECTIONS AND ADDITIONS TO THE ANALYSIS OF THE SINGLE-COLOR OFFSET PRESSMEN'S TRADE OFFERED BY VARIOUS PRESSMEN AND FOREMEN OF PRESSROOMS *

Name of Offset Press Operation	*Corrections Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
Placing gauge marks on the plate.	That for the first color the plate be placed on the table, face up, with sheet in position for printing upon it; that the edge of the sheet be marked directly opposite the side gauge marks on the plate, and that distance from mark to bearer or gear on the cylinder be measured.	Y ( ) N ( )
Cleaning back of plate.	That water instead of gasoline or kerosene be used.	Y ( ) N ( )
	That turpentine instead of kerosene be used.	Y ( ) N ( )
	That gasoline instead of kerosene be used.	Y ( ) N ( )

* The letter on page 67 was inserted between the title and the first item.

FORM 5 (*Continued*)

Name of Offset Press Operation	*Corrections Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
Gumming the plate before washing it out.	That gum be spread out smoothly and evenly before fanning the plate dry.	Y ( ) N ( )
Damping the plate.	That the plate be sponged and inked in before the dampers are thrown on.	Y ( ) N ( )
	That the dampers be sponged from one end to the other before starting the press in the morning.	Y ( ) N ( )
Putting plate on cylinder.	That gripper end of plate should be inserted first in clamps.	Y ( ) N ( )
	That palm of hand be rubbed over cylinder surface before putting on the plate.	Y ( ) N ( )
Setting front or gripper guides.	That when setting front guides the grippers should always be plainly visible; and that the guides should be set between the grippers so as to prevent possibility of damage from grippers closing down on guides.	Y ( ) N ( )
Comparing ink mixture with proof.	That finger not be used for daubing or tapping ink out.	Y ( ) N ( )
Mixing ink to match proof.	That ink may or may not be of the right consistency for press work when it comes from the can.	Y ( ) N ( )
Setting the skeleton wheels.	That printed sheet be run through the press to the skeleton wheels, then the wheels moved opposite blank spaces on sheet.	Y ( ) N ( )
Setting side guides on hand-fed press.	That measuring be done from the guide marks already on plate.	Y ( ) N ( )
Cleaning grained rollers.	That benzine is preferable because it leaves no grease and evaporates quickly.	Y ( ) N ( )
	That kerosene is O. K. for washings 1 and 2, but gasoline is best for last washing.	Y ( ) N ( )

FORM 5 (*Continued*)

Name of Offset Press Operation	*Corrections Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
Taking ink from fountain.	That benzine is preferable to kerosene.	Y ( ) N ( )
	That gasoline is preferable to kerosene.	Y ( ) N ( )
Removing plate from cylinder.	That back clamps be opened first.	Y ( ) N ( )
Adjusting automatic piler devices.	That it is always necessary to repile paper.	Y ( ) N ( )
Running trial impression sheets or securing the "lay."	That when starting the press the dampers should always contact with the plate before the impression cylinder lever is thrown on.	Y ( ) N ( )
Patching the blanket.	That paste rather than glue be used.	Y ( ) N ( )
Removing foreign substance (small bit of wood or paper) from surface of blanket.	That if knife is needed for removing foreign substance from blanket surface, then the surface is already ruined.	Y ( ) N ( )
Mending surface of blanket.	That rubber cement placed on blanket be covered with small patch of mending tissue before powder is put on.	Y ( ) N ( )
	That rubber cement, as a rule, is not as satisfactory for patching blanket as tailor's rubber patch heated and applied on similar material, such as gutta-percha or rubber compound.	Y ( ) N ( )
Cleaning blanket.	That benzine or gasoline is always preferable to any other solvent.	Y ( ) N ( )
Getting press ready for run in morning.	That quick-drying ink be removed from fountain at night.	Y ( ) N ( )
Cleaning surface plate cylinder.	That pumice stone never be used for this purpose.	Y ( ) N ( )
	That small knife and turpentine with rag be used.	Y ( ) N ( )
	That water and gasoline be used with rag.	Y ( ) N ( )

FORM 5 (*Continued*)

Name of Offset Press Operation	*Corrections Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
Cleaning cylinder bearers.	That pumice stone not be used.	Y ( ) N ( )
Reviving blanket.	That pumice stone is preferable to sand paper.	Y ( ) N ( )
Preparing plate for storeroom.	That gum be spread evenly, then fanned dry before washing out with tincture.	Y ( ) N ( )
Getting new blanket ready for press.	That blanket should be squared up in paper-cutting machine.	Y ( ) N ( )
Cleaning surface of impression cylinder.	That pumice stone never be used in this connection.	Y ( ) N ( )
	That plate be washed out with asphaltum solution.	Y ( ) N ( )
	Additions Suggested	
Washing plate with tincture.	Use dry rag and always rub with light rotary motion.	Y ( ) N ( )
Gumming the plate before washing it out.	That plate be washed with water first.	Y ( ) N ( )
Inking the rollers.	That the press be run with the "catch" on until the desired flow of ink results, then add ink to rollers with the knife as needed.	Y ( ) N ( )
	That the fountain always be set in accordance with the work on the plate, providing more ink for solids and less for more open type of design.	Y ( ) N ( )
Damping the plate.	That apprentices should be told the purpose of the acid in the water.	Y ( ) N ( )
	That apprentices should have explained to them the advantages and disadvantages of the different kinds of fountain etches.	Y ( ) N ( )
	That the danger from chromic poisoning be pointed out.	Y ( ) N ( )

FORM 5 (*Continued*)

Name of Offset Press Operation	*Additions Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
	That close relationship between fountain water and the following be pointed out: kind of work on plate, ink and paper; length of run and the plate itself.	Y( ) N( )
Putting plate on cylinder.	That plate be not drawn out of shape when tightening.	Y( ) N( )
Measuring thickness of plate.	That advantage of having uniform diameters on cylinder be thoroughly covered and that troubles which come from having diameters which are not uniform (blurring of impression, etc.) be pointed out to apprentices.	Y( ) N( )
Building up blanket or plate.	That tendency of certain types of blankets to swell and thus increase diameter of cylinder be mentioned to apprentices.	Y( ) N( )
Setting ink fountain.	That in adjusting fountain roller for feeding ink to distributing rollers, the mechanism be set so that the roller revolves three-fourths of its maximum distance for each revolution of the press.	Y( ) N( )
Comparing ink mixture with proof.	That two pieces of stock to be printed upon be used for daubing the ink out for purposes of comparison.	Y( ) N( )
	That samples of two inks be compared through small hole in paper.	Y( ) N( )
Mixing ink to match proof.	That the stronger and darker colors be added to weaker and lighter ones rather than the opposite.	Y( ) N( )
	That small rather than large quantities be used.	Y( ) N( )
	That the intensity of the color is always weakened when varnish or any other ingredient is added.	Y( ) N( )
	That the beginner be impressed with the idea that the less he meddles with his ink, the better, in the long run, for him.	Y( ) N( )

FORM 5 (*Continued*)

Name of Offset Press Operation	*Additions Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
	That the important relationship between variations in temperature, in paper, in the nature of the work, and the consistency of the ink be pointed out to the apprentice.	Y ( ) N ( )
Setting the skeleton wheels.	That the chief difficulty arising from skeleton wheels is their tendency to scratch or streak heavy solids; and that this tendency is being overcome by cutting the skeleton wheel surface to a point.	Y ( ) N ( )
Setting grippers on impression cylinder.	That occasionally the gripper which comes at extreme edge or corner of sheet must be opened and left open in order to secure good register.	Y ( ) N ( )
Setting form rollers.	That form rollers should have same diameter.	Y ( ) N ( )
	That while the method of setting form rollers varies on different presses the procedure, in general, should be:	
	(*a*) Set form rollers to the plate.	Y ( ) N ( )
	(*b*) Run plate under form rollers and drop riders down in place.	Y ( ) N ( )
	(*c*) Adjust each form roller so that .003 strip of paper will pull out evenly and not too hard from each end.	Y ( ) N ( )
	(*d*) Lock roller sockets and turn press until rollers are opposite gap on cylinders.	Y ( ) N ( )
	(*e*) Adjust riders to form rollers.	Y ( ) N ( )
	(*f*) Turn press until rollers are on plate once more and test again with slips of paper.	Y ( ) N ( )
	(*g*) Repeat, if necessary, until riders remain in constant contact with rollers, otherwise roller marks and tinting from scum will result.	Y ( ) N ( )
Cleaning grained rollers.	That No. 2 sandpaper be used.	Y ( ) N ( )
Taking ink from fountain.	That it is sometimes necessary to remove fountain blade and clean it.	Y ( ) N ( )

FORM 5 (*Continued*)

Name of Offset Press Operation	*Additions Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
Examining plate before putting it on press.	That the importance of examining the plate be emphasized to apprentices.	Y ( ) N ( )
	That following points be considered in the examination:	
	(*a*) How various designs on plate compare as to uniformity, as to amount of work, and as to firmness.	Y ( ) N ( )
	(*b*) Condition of grain of plate, color of plate, and stains, if any.	Y ( ) N ( )
Removing plate from cylinder.	That plate be gummed and rubbed down smooth when taken from press.	Y ( ) N ( )
Washing ink off rollers.	That shellacking smooth rollers is advisable when changing from dark to light color, e.g., blue to yellow.	Y ( ) N ( )
	That care be taken not to bend spindles or mar rollers.	Y ( ) N ( )
Adjusting pressure on impression cylinder.	That uniformity of cylinder diameters, wearing work off plate, register, etc., be stressed to apprentices.	Y ( ) N ( )
	That following procedure be taken in adjusting pressure:	
	(*a*) Take two 2-inch strips of stock to be run and place one piece on each end of impression cylinder.	Y ( ) N ( )
	(*b*) Put on pressure and adjust screws until paper slips can barely be drawn through.	Y ( ) N ( )
	(*c*) Then add four facings of pressure for printing.	Y ( ) N ( )
Adjusting automatic feed devices (*a*) cones (*b*) feet (*c*) blowers (*d*) suction devices (*e*) bars (*f*) push fingers (*g*) pulleys, etc.	That push fingers be set so as not to smear sheet already printed.	Y ( ) N ( )

FORM 5 (*Continued*)

Name of Offset Press Operation	*Additions Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
Changing the consistency of the ink.	That the stronger (less reduced) the color, the better.	Y ( ) N ( )
	That attention be called to ease with which ink may be thinned or softened, and how hard it is to stiffen or strengthen it.	Y ( ) N ( )
	That the tendency is to mix ink too thin rather than too stiff.	Y ( ) N ( )
	That the stiffer the ink, the better for the majority of jobs.	Y ( ) N ( )
	That quality of paper is an important factor to consider.	Y ( ) N ( )
	That each addition of varnish or other reducer cuts down the strength proportionally, and, that since strength of color is all-important in offset printing, the beginner be warned against sacrificing strength for easy working properties.	Y ( ) N ( )
	That very little varnish will change the working properties of ten or twenty pounds of ink.	Y ( ) N ( )
	That the ink be shortened with thin varnish for fast drying when bronze is run last.	Y ( ) N ( )
Building up impression cylinder.	That impression on blanket be examined and that if found O. K. more pressure on printing cylinder is needed.	Y ( ) N ( )
Checking for proper color of ink.	That attention be called to possibility of ink changing color when it dries, especially reds, milori blues, and grays.	Y ( ) N ( )
Checking impression for proper register.	That faulty transfers may be the source of trouble.	Y ( ) N ( )
Adjusting plate on cylinder.	That if plate is to be shifted on one side only, care must be taken not to cause the plate to buckle by loosening it too far only part-way across.	Y ( ) N ( )
Cleaning sand or grit off form rollers.	That if grit cannot be definitely located, the entire roller be scraped.	Y ( ) N ( )

FORM 5 (*Continued*)

Name of Offset Press Operation	*Additions Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
Patching the blanket.	That thin paper be used and that if more than one piece is needed, pieces be graduated off.	Y( ) N( )
Removing foreign substance (small bit of wood or paper) from surface of blanket.	That if brush is properly set, foreign substances will not get to blanket surface.	Y( ) N( )
Changing consistency of water mixture.	That "dope," since it is a chemical, must be dealt with carefully at all times and that good results come only when the amounts used are carefully measured.	Y( ) N( )
	That it may be too late to remedy matters when plate shows evidence of water being too strong.	Y( ) N( )
	That minimum amount of "dope" be used for keeping plate in condition.	Y( ) N( )
Gumming plate during the run.	That plate always be gummed when press is stopped for any length of time.	Y( ) N( )
	That plate always be fanned dry after gumming.	Y( ) N( )
Cleaning blanket.	That turpentine and kerosene tend to soften the blanket and cause it to swell, while benzine tends to keep it hard.	Y( ) N( )
Tending press during run.	The back of sheet be watched for offsetting.	Y( ) N( )
Etching portion of design on plate.	That the etching solution should be weak unless plate is powdered with rosin or talc.	Y( ) N( )
Polishing out parts of design.	That unless extreme care is exercised the spot which has been polished out will work up again.	Y( ) N( )
	That scumming of plate is more likely after polishing has been resorted to.	Y( ) N( )
Cleaning surface of plate.	That surface of cylinder be oiled before putting plate on.	Y( ) N( )

FORM 5 (*Continued*)

Name of Offset Press Operation	*Additions Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
Cleaning water fountain.	That thin film of gum be rubbed over brass fountain roller and fanned dry.	Y ( ) N ( )
Sulphiding or hardening surface of bracket.	That carbon disulphide be mixed with flowers of sulphur, five parts or portions of the former to one part of the latter.	Y ( ) N ( )
Setting the delivery grippers.	That care be taken when performing this operation not to loose the opening of the grippers.	Y ( ) N ( )
	That on presses which use individual gripper pads, the procedure be:	
	(*a*) Place strip of .0015 thickness under stop.	Y ( ) N ( )
	(*b*) Open up all grippers.	Y ( ) N ( )
	(*c*) See that feeler gauge is tight.	Y ( ) N ( )
	(*d*) Set individual grippers, one at a time, lightly on gripper pad starting from center and working out to ends.	Y ( ) N ( )
	That procedure be as follows where there is a stop on gripper end:	
	(*a*) Place piece of paper .005 thickness under stop on gripper rod.	Y ( ) N ( )
	(*b*) Set each gripper so that stock to be run pulls evenly from all points.	Y ( ) N ( )
	That where there is no stop on gripper rod, the procedure be:	
	(*a*) Loosen all but two end grippers.	Y ( ) N ( )
	(*b*) Place piece of paper under one of end grippers.	Y ( ) N ( )
	(*c*) Now place thickness of paper (necessary for even pull) under the other end gripper.	Y ( ) N ( )
	(*d*) See that the pull is even on the two pieces.	Y ( ) N ( )
	(*e*) Set the remaining grippers in the same way and tighten.	Y ( ) N ( )
	That on the spring type of gripper, the block which lifts each gripper should have an even clearance of .010 if the spring is to do its work properly.	Y ( ) N ( )
Putting blanket on cylinder.	That some presses now provide worm-gear device for tightening blanket.	Y ( ) N ( )

FORM 5 (*Continued*)

Name of Offset Press Operation	*Additions Suggested*	*Check Showing Approval (Y), or Disapproval (N)*
Getting new blanket ready for press.	That some presses now have clamps which make it unnecessary to punch holes in blanket.	Y( ) N( )
Cleaning surface of impression cylinder.	That kerosene or benzine with knife be used.	Y( ) N( )
Getting press ready for the night.	That plate be gummed and rubbed down with damp piece of cheese cloth.	Y( ) N( )
	That impression cylinder be cleaned because ink comes off easily when fresh, but is difficult to remove when hardened.	Y( ) N( )

SUGGESTED CHANGES REGARDING DIFFICULTIES WHICH APPEAR ON THE PRINTED SHEET

Name of Defect	*Additional Causes Suggested*	*Check Showing Approval (Y), or Disapproval (N)*	*Additional Remedies*	*Check Showing Approval (Y), or Disapproval (N)*
Impression is faint, the faintness extending evenly over the entire design.	Too much water is getting to the plate.	Y( ) N( )	To increase flow of ink add another tooth on ratchet which controls fountain roller.	Y( ) N( )
Impression looks uneven—shows ink at all points but in varying amounts.	Variations in thickness of sheet.	Y( ) N( )		
	Blanket has become glazed.	Y( ) N( )	Wash thoroughly with benzine after opening up surface by rubbing with pumice stone.	Y( ) N( )
Design looks "blotchy" — lacks regularity in depth.	Feeder rollers are pulling up surface of sheet.	Y( ) N( )		
	Feeder brushes may be scratching surface of the sheet.	Y( ) N( )	Softening the ink is recommended.	Y( ) N( )
Impression is "muddy" in spots —ink is "piled up" on sheet.	Too much pressure.	Y( ) N( )		
Impression registers either "short" or "long."	Plate cylinder not adjusted properly.	Y( ) N( )		
	Pressure bars need adjusting (on certain make of press).	Y( ) N( )		
	Stop guides are out of line (on certain presses).	Y( ) N( )		
	Diameters on the plate and the blanket cylinders are not the same.	Y( ) N(		

FORM 5 (*Continued*)

Name of Defect	*Additional Causes Suggested*	*Check Showing Approval (Y), or Disapproval (N)*	*Check Showing, Additional Approval (Y) on Remedies Disapproval (N)*
Impression shows that fine lines of design are disappearing—are "fading out."	Mica on the paper may be responsible.	Y( ) N( )	
When the impression registers accurately on gripper end of sheet it registers inaccurately on the back end.	Pressure bars may not be adjusted properly.	Y( ) N( )	
	Inaccurate transfer.	Y( ) N( )	
Design looks darker or lighter than proof.	Too much ink gives same effect as darker ink.	Y( ) N( )	
	Plate may not be correct.	Y( ) N( )	
Design lacks sharpness of details.	Impure spots in zinc plates.	Y( ) N( )	
Sheet shows that plate is printing from undeveloped portions.	Brass fountain roller has collected some grease.	Y( ) N( )	
	Damper is greasy.	Y( ) N( )	
	Ink is too greasy.	Y( ) N( )	
	Transfer stain is showing up.	Y( ) N( )	
	Ink is washing or bleeding.	Y( ) N( )	
	Plate has oxidized.	Y( ) N(	
Impression is blurred across back end of sheet.	Blanket is not tight enough.	Y( ) N( )	
	Pressure is too strong.	Y( ) N( )	
Design shows "roller marks."	Skin on leather-covered roller is loose.	Y( ) N( )	
	Damper is loose.	Y( ) N( )	
Design shows "gear streaks."	"Back leash" gears need tightening.	Y( ) N ( )	
	Cylinder bearers need cleaning.	Y( ) N( )	
	Gear or segment on cylinder is split.	Y( ) N( )	
Design is weak "washed out," spotty.	Water too strong for the ink.	Y( ) N( )	
Impression registers accurately only in certain sections of sheets.	Stops on impression cylinder are out of line (on certain presses only).	Y( ) N( )	
Impression registers sometimes too far to the left and again too far to the right.	Side guide (push type) not square with side of sheet.	Y( ) N( )	

FORM 6

The Various Body Colors Used by Offset Pressmen and the Working Properties of Each

Directions: Place check mark in each of the Y ( ) if you agree with statement
Place check mark in each of the N ( ) if you do not agree with statement

Name of Ink	Working Properties							
	Degree of Opaqueness	Degree of Permanency	Susceptibility to					Special Characteristics
			Heat	Alkali	Alcohol	Acids	Acids in Water	
Yellows:								
Chrome Yellows.	Large Y( ) N( )	Large Y( ) N( )	Good Y( ) N( )	Poor Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Heavy inks Y( ) N( )
Chrome Oranges.	Large Y( ) N( )	Large Y( ) N( )	Good Y( ) N( )	Poor Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Heavy inks Y( ) N( )
Yellow Lakes....	Small Y( ) N( )	W. var. Y( ) N( )	W. var. Y( ) N( )	W. var. Y( ) N( )	Usually bleeds Y( ) N( )	W. var. Y( ) N( )	Usually good Y( ) N( )	Bulky inks Y( ) N( )
Iron Blues:								
Milori.....	Medium Y( ) N( )	Large Y( ) N( )	Good Y( ) N( )	Poor Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Medium bulky Y( ) N( )
Prussian.....	Medium Y( ) N( )	Large Y( ) N( )	Good Y( ) N( )	Poor Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Medium bulky Y( ) N( )
Bronze.....	Medium Y( ) N( )	Large Y( ) N( )	Good Y( ) N( )	Poor Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Medium bulky Y( ) N( )
Ultramarine.....	Medium Y( ) N( )	Large Y( ) N( )	Fine Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Poor Y( ) N( )	Medium Y( ) N( )	Poor working ink Y( ) N( )
Blue Lakes:								
Peacock.....	Small Y( ) N( )	Usually fug. Y( ) N( )	W. var. Y( ) N( )	W. var. Y( ) N( )	Usually bleeds Y( ) N( )	W. var. Y( ) N( )	Good Y( ) N( )	Tends to brilliancy Y( ) N( )
Oriental.....	Small Y( ) N( )	W. var. Y( ) N( )	W. var. Y( ) N( )	W. var. Y( ) N( )	W. var. Y( ) N( )	W. var. Y( ) N( )	Good Y( ) N( )	Tends to brilliancy Y( ) N( )
Alkali Blues.....	Small Y( ) N( )	Med. Y( ) N( )	Med. Y( ) N( )	Med. Y( ) N( )	Usually bleeds Y( ) N( )	Good Y( ) N( )	Good Y( ) N( )	Tends to brilliancy Y( ) N( )

Reds:																	
Madder Lakes...	Very small	Y( ) N( )	Large	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )	Fairly good	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )	Bulky inks	Y( ) N( )
Mercury Vermilion.....	Large	Y( ) N( )	Large	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )	Med.	Y( ) N( ))	Med.	Y( ) N( )	Poor working ink	Y( ) N( )
Para Reds.....	Medium	Y( ) N( )	Large	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )	Poor	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )	Bleeds	Y( ) N( )
Toluidines.....	Medium	Y( ) N( )	Large	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )		
Lithol Reds.....	Medium	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )		
Purples and Violets:																
Permanent.....	Med.	Y( ) N( )	Large	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )		
Fugitive.....	Med.	Y( ) N( )	Small	Y( ) N( )	Good	Y( ) N( )	Poor	Y( ) N( )	Poor	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )		
Orange Lakes:																
Persian.....	Very small	Y( ) N( )	Very small	Y( ) N( )	Med.	Y( ) N( )	Poor	Y( ) N( )	Med.	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )		
Permanent.....	Very small	Y( ) N( )	Large	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )		
Greens:																
Green Lakes....	Very small	Y( ) N( )	W. var.	Y( ) N( )	W. var.	Y( ) N( )	W. var.	Y( ) N( )	Med.	Y( ) N( )	Med.	Y( ) N( )	Good	Y( ) N( )	Tends to brilliancy	Y( ) N( )
Chrome Greens..	Large	Y( ) N( )	Large	Y( ) N( )	Large	Y( ) N( )	Poor	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )	Good	Y( ) N( )	Heavy ink	Y( ) N( )

W. var. = wide variation; Fug. = fugitive; Med. = medium

1. Heavy has reference to gravity, not to body.
2. A pound of bulky ink on same form will go further than a pound of heavy ink.
3. Some peacock blues are quite permanent, but when so, they lack the brilliancy of the fugitive ones.

FORM 7

Ingredients Used by Offset Pressmen When Mixing Inks and the Chief Working Properties of Each

The check mark opposite an ingredient indicates that it possesses the property listed directly above.
Directions: Place check mark in each of the Y ( ) if you agree with statement.
Place check mark in each of the N ( ) if you do not agree with statement.

Name of Ingredient	Chief Working Properties								
	Reduces * Both Depth and Strength of Color	Softens the Ink	Stiffens the Ink	Adds to Glossiness	Keeps Ink Flat	Makes Ink Dry Faster	Slows Up Drying	Increases Tackiness	Decreases Tackiness
Vaseline Compounds	*Y( ) N( )				*Y( ) N( )		*Y( ) N( )		*Y( ) N( )
Paraffin Wax	*Y( ) N( )		*Y( ) N( )						*Y( ) N( )
Kerosene	*Y( ) N( )	*Y( ) N( )			*Y( ) N( )		*Y( ) N( )		*Y( ) N( )
Magnesia Powder	*Y( ) N( )		*Y( ) N( )		*Y( ) N( )			*Y( ) N( )	
Laketine	*Y( ) N( )				*Y( ) N( )				*Y( ) N( )
Aluminum Hydrate Ink	*Y( ) N( )			*Y( ) N( )				*Y( ) N( )	
Lard Oil	*Y( ) N( )	*Y( ) N( )			*Y( ) N( )		*Y( ) N( )		*Y( ) N( )
Wool Grease	*Y( ) N( )				*Y( ) N( )		*Y( ) N( )		
Tallow	*Y( ) N( )				*Y( ) N( )		*Y( ) N( )		*Y( ) N( )
Palm Oil	*Y( ) N( )	*Y( ) N( )					*Y( ) N( )		*Y( ) N( )
Castor Oil	*Y( ) N( )	*Y( ) N( )					*Y( ) N( )		*Y( ) N( )
Oleic Acid	*Y( ) N( )	*Y( ) N( )					*Y( ) N( )		*Y( ) N( )
Mineral Oil	*Y( ) N( )	*Y( ) N( )					*Y( ) N( )		*Y( ) N( )
Covering White (Opaque)	*Y( ) N( )								
Mixing White (Semi-opaque)	*Y( ) N( )								
Liquid Driers (Japan)	*Y( ) N( )	*Y( ) N( )		*Y( ) N( )		*Y( ) N( )			*Y( ) N( )
Paste Driers	*Y( ) N( )			*Y( ) N( )		*Y( ) N( )			
00000 Varnish	*Y( ) N( )	*Y( ) N( )			*Y( ) N( )				*Y( ) N( )
000	*Y( ) N( )	*Y( ) N( )			*Y( ) N( )				*Y( ) N( )
00	*Y( ) N( )	*Y( ) N( )			*Y( ) N( )				*Y( ) N( )
0	*Y( ) N( )	*Y( ) N( )							*Y( ) N( )
1	*Y( ) N( )	*Y( ) N( )							
2	*Y( ) N( )	*Y( ) N( )							
3	*Y( ) N( )								
5	*Y( ) N( )		*Y( ) N( )	) *Y( ) N( )				*Y( ) N( )	
7	*Y( ) N( )		*Y( ) N( )	) *Y( ) N( )				*Y( ) N( )	
8	*Y( ) N( )		*Y( ) N( )	) *Y( ) N( )				*Y( ) N( )	
Raw Linseed Oil	*Y( ) N( )	*Y( ) N( )							
Boiled Linseed Oil	*Y( ) N( )	*Y( ) N( )			*Y( ) N( )	*Y( ) N( )			

* The addition of any colorless ingredient to a body color always reduces the *strength* in direct proportion to the amount added; it also always reduces the *depth*, but the amount in such cases varies with the reducer used.
Strength has reference to the relative amount of coloring matter per unit of weight.
Depth of color depends upon the apparent absence of white in the printed ink.

B. Offset Inks and the Ingredients Used When Mixing

It will be recalled that Forms 1, 2, and 3 (pages 10, 11, and 12) were used for recording the judgments of one expert regarding the working properties of offset inks and the ingredients used by pressmen when mixing inks, and that the judgments of this expert appear in Charts 1, 2, and 3 (pages 13, 14, and 15). In order to find out whether or not these judgments accorded with the judgments of others, Charts 1, 2, and 3 were submitted for approval or disapproval to nine other experts, namely, chemists in four ink manufacturing plants, two foremen of ink departments in lithographing establishments, and three offset pressmen, all of whom were employees of subscribers to the Foundation.

The manner in which these were submitted is indicated in Forms 6 and 7 [3] (pages 82, 83, and 84). The accessibility of the experts in this instance made it possible for the investigator to deliver the forms, explain their purpose, and make a personal request for assistance. A tabulation of the returns (see Tables III and IV, pages 87, 89), shows that agreement to the extent of 90 per cent prevailed; that the agreement among chemists was almost perfect, and that the offset pressmen evidently felt unqualified to comply in full with the request.

The results secured from the use of Form 5 are shown in Table III; those secured from the use of Form 6 are shown in Table IV; and those secured from Form 7 are shown in Table V.

[3] Due to the nature of the information on Chart 3 it was not considered advisable to prepare a special form for it. The investigator conferred personally with ink chemists regarding it and found it to be accurate but incomplete.

CHAPTER V

INTERPRETATION AND EVALUATION OF THE VERIFYING PROCEDURE

Three fundamental questions may be raised with regard to the method of verifying the analysis: (1) Did the investigator go to the right sources when checking for accuracy and thoroughness? (2) Was a sufficient number of persons approached? (3) Were these persons approached in a manner which would insure willing and conscientious coöperation on their part? A fourth question, pertaining to the accuracy of the data submitted rather than to the method of submitting them, might also be raised, namely: Does a critical analysis of the returns show a high degree of agreement among the persons to whom the data were submitted? These questions are considered in the order in which they are stated.

A. Offset Press Operations and Lithographing Defects

1. *Proper Persons Approached.* An examination of the responses [1] to the letter which accompanied the analysis shows that in nine of fourteen instances every item in the analysis was checked and that the suggestions were made either by the pressroom foreman or his assistant; they further show that in the remaining five instances the suggestions were made either by the superintendent, the factory manager, or the head of the lithographing department. It may be safely assumed, therefore, that the proper persons were appealed to and that they critically examined the analysis.

Examination of the returned lists of suggestions (Form 5, page 70), submitted for approval or disapproval to the eleven persons shows that without exception the judgments are those of the pressroom foreman. It follows, therefore, that only experts were

[1] Thirty-six of the sixty-seven firms to which the analysis was sent acknowledged its receipt. Of the thirty-six replies, nine were purely perfunctory in character, eight were in the nature of "blanket" approvals, though in each instance they contained this statement or its equivalent: "We passed the analysis on to our pressroom foreman with the request that he read it carefully and criticize. He reports that he has done so and has no criticisms to make." Four sent detailed criticisms in typed form but did not return the manuscript, while fourteen returned the manuscript with criticisms inscribed thereon and indicated the type of expert who made them.

TABLE III

NUMBER OF REPLIES AND TYPE (WHETHER POSITIVE OR NEGATIVE) TO EACH OF 124 SUGGESTIONS ON PRESS OPERATIONS

No. of Suggestion on List	No. Replying	No. of Affirmative Replies	No. of Negative Replies	No. of Suggestion on List	No. Replying	No. of Affirmative Replies	No. of Negative Replies	No. of Suggestion on List	No. Replying	No. of Affirmative Replies	No. of Negative Replies
1	9	9	0	41	11	11	0	83	11	11	0
2	9	8	1	42	11	11	0	84	10	10	0
3	8	6	2	43	11	11	0	85	10	10	0
4	8	7	1	44	11	11	0	86	8	8	0
5	11	11	0	45	11	11	0	87	10	10	0
6	9	5	4	46	10	10	0	88	10	10	0
7	11	11	0	47	11	11	0	89	11	11	0
8	11	11	0	48	11	11	0	90	9	9	0
9	10	10	0	49	7	5	2	91	11	11	0
10	10	10	0	50	10	9	1	92	10	10	0
11	8	8	0	51	10	10	0	93	10	8	2
12	10	10	0	52	10	10	0	94	10	10	0
13	11	11	0	53	11	11	0	95	11	10	1
14	10	9	1	54	11	10	1	96	10	10	0
15	10	10	0	55	10	10	0	97	11	11	0
16	9	8	1	56	9	9	0	98	11	9	2
17	9	7	2	57	10	9	1	99	11	11	0
18	10	8	2	58	9	8	1	100	11	11	0
19	11	11	0	59	9	9	0	101	10	10	0
20	10	4	6	60	9	9	0	102	11	11	0
21	11	0	0	61	9	9	0	103	10	10	0
22	10	9	1	62	9	9	0	104	10	8	2
23	9	6	3	63	10	10	0	105	10	8	2
24	7	5	2	64	8	8	0	106	8	7	1
25	10	8	2	65	9	9	0	107	8	8	0
26	11	11	0	66	10	10	0	108	8	8	0
27	11	11	0	67	9	9	0	109	8	8	0
28	10	7	3	68	10	9	1	110	7	7	0
29	6	4	2	69	10	9	1	111	8	8	0
30	9	8	1	70	9	9	0	112	8	8	0
31	11	8	3	71	10	9	1	113	8	8	0
32	9	9	0	72	10	5	5	114	8	8	0
33	11	11	0	73	10	10	0	115	7	7	0
34	11	11	0	74	11	11	0	116	8	8	0
35	11	9	2	75	9	9	0	117	8	8	0
36	11	11	0	76	8	8	0	118	8	8	0
37	10	10	0	77	8	8	0	119	8	8	0
38	10	9	1	78	10	10	0	120	7	7	0
39	10	10	0	79	11	11	0	121	6	6	0
40	11	11	0	80	9	9	0	122	11	10	1
				81	10	10	0	123	11	11	0
				82	11	11	0	124	11	11	0

used. That such experts gave the matter serious consideration is attested by the fact that 88 per cent of the possible checkings were checked, or, in other words, that there were but 12 per cent blanks.

A point which must not be overlooked in this connection is that, without exception, the persons whose assistance was sought and secured were either subscribers to the Foundation or employees of such subscribers. The nature of the letters acknowledging the receipt of the analysis and accompanying its return justifies the assumption that to the request of the Managing Director for criticisms was added the full force of executive authority when the analysis was transmitted to the various experts.

2. *Representative Sources Utilized.* The fourteen persons who responded in full to the request for suggestions regarding the accuracy and completeness of the analysis represent twelve lithographing establishments in the following centers: Los Angeles, San Francisco, Chicago, Boston, Buffalo, New York, Rochester, and Cleveland. The remaining persons, whose responses were not detailed in nature, add four more to the list of cities: Washington, Philadelphia, Hartford, and Milwaukee. The eleven experts who responded to the request for approval or disapproval of each of the 124 suggestions represent the following cities: Buffalo, Rochester, Chicago, Washington, Philadelphia, Boston, and New York. Manifestly, therefore, the analysis represents trade practice as a whole rather than as found in any restricted area.

3. *Sufficient Sources Utilized.* Statisticians now agree that the testimony of a few experts in a given field is fully as reliable as that of many hundred non-experts. It may be assumed, therefore, that little if anything of value would have been gained if the number of satisfactory responses to the request for suggestions on the analysis had been 118 rather than 18, or if the number of experts used for verifying the data on ink had been much larger.

4. *Method of Approach Suitable.* That the letter of the Managing Director coupled with the appeal or order of the chief plant executive was sufficient to secure the desired criticism is evidenced by the number of comprehensive responses received. It is indicated also by the relatively few questions raised with regard to the meaning of statements both in the analysis and in the list of suggestions to the analysis. Finally, it is indicated by the large degree of agreement found to prevail (see Table III) among the

TABLE IV

DISTRIBUTION OF POSITIVE AND NEGATIVE JUDGMENTS AND BLANKS ON WORKING PROPERTIES OF OFFSET INKS *

	Degree of Opaqueness	Degree of Permanency	Working Properties					
			Susceptibility					
			To Heat	To Alkali	To Alcohol	To Acids	To Acids in Water	Totals
Chemists	105 *	104	96	96	102	78	104	685
	0	0	8	8	2	26	0	44
	0	1	1	1	1	1	1	6
Foremen of Ink Departments	34	34	40	39	36	40	39	262
	8	8	1	2	5	1	2	27
	0	0	1	1	1	1	1	5
Pressroom Foremen and Offset Pressmen	50	49	35	10	10	29	55	238
	8	9	7	10	10	0	1	45
	5	5	21	43	43	34	7	158
Totals	210	210	210	210	210	210	210	1,470

* The first number in each instance represents the positive judgments; the second, the negative ones; the third, the blanks.

eleven experts. Table III shows marked difference of opinion on less than a half dozen items, complete agreement on 88 of the 124 items, and but one negative vote on 13 per cent of the remaining items; in short, it shows agreement to the extent of approximately 84 per cent.

B. Offset Inks

As to the satisfactoriness of the procedure in this connection little need be said, since only experts, ten in number, were approached, all of whom were interested in the success of the investigation. The partial analysis of the returns found in Table IV, page 89, shows: (*a*) noteworthy absence of negative judgments, actually about 10 per cent on 13 of the 21 items; (*b*) relatively wide disagreement on three items only; and (*c*) a relatively large number of blanks in the cases of the pressroom foremen and the offset pressmen.

It is especially significant that so little disagreement obtains with respect to degree of opaqueness, permanency, and susceptibility to acids in water, since these play such an important part in offset (paper) lithography. The large number of blanks on susceptibility to heat, to alkali, to alcohol, and to acids is doubtless explained by the fact that the critics did not feel competent to reply.[2] Presumably the type of work performed in the plants where these men are employed does not call for knowledge of these points.

The large number of negative judgments recorded by chemists on susceptibility to acids was found upon investigation to be due to a misunderstanding on the part of two chemists both of whom were employees of the same company. Following a conference, at which the meaning of a specific term was explained, the judgments were reversed.

C. Working Properties of the Ingredients Used

No further evidence as to the appropriateness of technique employed in this connection need be cited than the remarkably small number of negative judgments—less than 5 per cent in all —obtained from the experts (Table V, page 91) and the degree to which agreement prevails. Apparently agreement among the

[2] The individual forms returned show that two persons, one a pressroom foreman in a metal lithographing plant, the other an offset pressman in a plant which specializes in posters, were responsible for all but 11, or for 92 per cent, of the blanks.

TABLE V

DISTRIBUTION OF POSITIVE AND NEGATIVE JUDGMENTS AND BLANKS ON WORKING PROPERTIES OF INGREDIENTS USED IN MIXING OFFSET INKS

	CHIEF WORKING PROPERTIES									
	Reduces Both Depth and Strength	Softens the Ink	Stiffens the Ink	Adds to Glossiness	Keeps Ink Flat	Makes Ink Dry Faster	Slows Up Drying	Increases Tackiness	Decreases Tackiness	Totals
Chemists	142	72	25	29	51	15	43	22	72	471
	8	2	0	1	0	0	2	3	3	11
	0	1	0	0	4	0	0	0	0	5
Foremen of Ink Departments	50	25	8	11	22	6	16	8	25	171
	1	3	1	0	0	0	0	2	2	9
	9	2	1	1	0	0	2	0	3	18
Pressroom Foremen and Offset Pressmen	70	36	15	10	26	8	9	12	32	218
	2	0	0	6	4	0	0	2	6	20
	18	9	0	2	3	1	18	1	7	59
Totals	300	150	50	60	110	30	90	50	150	982

ten persons obtains to a far greater extent with regard to the working properties of the ingredients used by pressmen when mixing inks than with regard to the properties of inks. The relatively large number of blanks attributed to the three pressroom foremen and offset pressmen is doubtless due either to uncertainty or ignorance on the part of one pressroom foreman from a metal lithographing plant who was responsible for all of the blanks.

CHAPTER VI

SUMMARY AND CONCLUSIONS TO PART I

As stated in the Introduction, the primary purpose of this investigation was to analyze the offset pressman's trade for a definite purpose, namely, that basic instructional material and a course of study might be prepared for apprentices. The analysis is finished and, so far as the writer is aware, it constitutes the most detailed one ever made for the same purpose; moreover, it is believed to represent trade practice as accurately as any other published analysis. The investigator's reasons for this belief are based upon the soundness of the techniques employed both for securing and for verifying the various types of data, and upon the results of the verifying procedure. It is, in fact, the techniques or rather the ways in which old techniques were used that entitle this investigation to be called a contribution. A brief statement of the procedure and the results follows.

After gaining access to the plants where the trade in question was being practiced the investigator devoted practically all of his time for several days to gaining a general idea of the trade and acquiring its terminology. During this period it was tentatively decided that operations rather than jobs should constitute the basis of procedure and that information of the following types would be sought:

1. Names of the various operations in the trade.
2. Steps taken in performing each operation.
3. The reason for performing each operation and for taking each step in the operation.
4. Knowledge essential to the satisfactory performance and understanding of each operation.

Following this, the procedure, in brief, consisted of procuring and organizing the data, checking them as to accuracy and completeness, conferring with expert tradesmen regarding suggested corrections, and revising in accordance with the results of successive conferences.

In completed form, the analysis consisted of eighty-five operations largely of mechanical nature, though involving considerable technical knowledge, and thirty-two defects with their respective causes and remedies. These data were verified by sending them in mimeographed form to sixty-seven subscribers to the Foundation with a request for criticisms in the form of corrections or additions. The 124 corrections and additions which came from this request were arranged in such form that an affirmative or negative reaction to each could be secured and sent to experts in eleven prominent lithographing establishments. The data on offset inks and on ingredients used in mixing inks were likewise submitted to experts, the experts in this case consisting of chemists in ink manufacturing plants, of offset pressmen, and of foremen of pressrooms and ink departments in lithographing plants. An analysis and interpretation of the returns was then made, attention being given especially to the amount of agreement among the members of the trade and to the accuracy of the data as a whole.

Before attempting to designate the distinctive features of the technique, the circumstances which had most important bearing upon the analysis and the method of conducting it will be summarized:

1. The investigator had never worked at the trade being analyzed, in fact had never seen the trade practiced.

2. The tradesmen with whom the investigator coöperated both when procuring and verifying the data were, without exception, employees of subscribers to the Lithographic Technical Foundation under whose auspices and for whose benefit the investigation was carried on.

3. The tradesmen with whom the investigator conferred were not only kindly disposed at all times but also anxious to assist in every way possible toward making the investigation a success.

4. Those from whom the information was procured were without exception recognized experts in their respective fields of work.

5. The investigator was permitted to spend as much time as he desired in the pressrooms of the lithographing plants.

6. No investigation of similar character had ever been made in the lithographic industry.

7. No trade, in which ability to detect and correct defects constitutes such an important part, had hitherto been analyzed.

Since certain characteristics of the offset pressman's trade also bear importantly upon the method of analysis employed, they are also enumerated:

1. Though a machine trade, the demands made upon those who practice it are strongly technical as well as mechanical.

2. The practice of the trade requires continuous dealing with such variables as rubber blankets, ink, paper, plates, and the work on the plates, and therefore necessitates frequent and accurate use of judgment on the tradesman's part.

3. Ability to detect forty or more kinds of defects which appear on the finished product as it comes from the machine, to attribute each of these to its proper cause or causes, and to apply the correct remedy in each instance constitutes an important part of the trade.

4. Satisfactory completion of the simplest kind of production job in this trade necessitates knowledge and ability to perform several operations as a consequence of which the completion of a production job could probably not be effected by a beginner in less than twenty to twenty-five hours.

Unique features of the method employed are:

1. The investigator established and maintained intimate contact with members of the trade and depended almost exclusively upon them for his information.

2. The investigator procured the major part of the desired data by observing trade practice and by asking questions about such practice.

3. To insure accuracy all data were organized as soon as procured and submitted to a limited number of coöperating members of the trade for approval or disapproval.

4. As not all of the necessary trade or technical knowledge could be secured from one tradesman, many were consulted.

5. The press-operations phase of the analysis (Part I) falls under the following categories: (1) What is done. (2) How it is done. (3) Why it is done. (4) What one must know in order to do it.

6. The strictly technical information was secured largely from manufacturers of materials and equipment used regularly by members of the trade.

7. The lithographing-defects phase (see B of the analysis, page 57) is the outcome of many days of close observation, questioning,

checking, and re-checking following repeated conferences with coöperating tradesmen. On several occasions sheets showing significant defects were laid aside by pressmen and preserved for days for the investigator.

8. All data of strictly mechanical nature were submitted for verification, in accordance with the best scientific procedure, to sixty-seven representative tradesmen in various parts of the country.

9. The corrections and additions secured from submitting the analysis to the sixty-seven representative tradesmen were re-checked as to accuracy by eleven selected experts.

10. All data of strictly technical nature were verified as to accuracy by ten experts including ink chemists, pressroom foremen, and offset pressmen.

Outstanding features of the investigation are:

1. Only accepted techniques were used in making the analysis, but, as already stated, these were adapted to serve new purposes.

2. The high degree of agreement found among the responses of the eleven experts who recorded acceptance or rejection of each item on the list of 124 suggested changes (see Chapter IV) shows conclusively that the techniques were appropriate for the purpose. This is further indicated by the almost unanimous agreement among the ink chemists and others relative to the working properties of offset inks and ingredients used when mixing inks (see Chapter V).

3. The high degree of agreement also signifies that the data are largely accurate. The accuracy of the analysis is further attested by the gratifying approval voiced by numerous subscribers to the *Basic Texts for Lithographic Apprentices*, since developed from these data.

4. For the first time, so far as the writer is aware: (1) a machine trade was analyzed through the coöperation of an analyst and tradesmen; (2) the observation-question method was employed in analyzing a trade; (3) the results of the analysis were verified according to accepted scientific methods; (4) the defects or difficulties with which members of the trade contend regularly were catalogued in conjunction with their respective causes and remedies and made an important part of the trade content.

5. A trade analysis was consciously based upon and developed

from the four captions: what to do, how to do it, why do it, and what one needs to know in order to do it.

The experiences of the investigator in making this analysis justify certain significant conclusions which should prove valuable to others. The more important of these follow: There seems to be no reason why the techniques employed in this instance cannot be successfully used in analyzing numerous other trades. The guide posts, so to speak, for the analyst as expressed in the four captions, what is done, how it is done, why it is done, and the knowledge necessary, will undoubtedly meet the needs of a vast number, if not all, of mechanical trades and hand trades.[1] The same may be said for the observation-question method of getting information. It can be successfully used so long as members of the trade involved coöperate satisfactorily. It cannot be overemphasized, however, that willingness to coöperate on the part of tradesmen is absolutely vital to the success of the method.

The location and tabulation of defects which mark the finished product in the various trades could doubtless be accomplished by the same careful and laborious procedure employed in the present instance. There is a real question in the writer's mind, however, as to whether it would be worth while to do so in the majority of trades. The verifying measures employed could be used in analyzing any trade provided the right kind of coöperation is obtainable. While no one knows in this instance how much the attitude of the tradesmen was due to the fact that the Foundation was sponsoring the investigation, it is believed that it was not appreciably affected thereby. In the writer's judgment, it may be safely assumed that an equally commendable spirit of progressiveness and coöperation would be found among the members of practically all other trades.

In conclusion, attention is called to a previously mentioned but possibly insufficiently stressed success factor (page 9); an investigator's ability to observe, to get at the vital principles involved, and to get these organized on paper so that they could be read and understood by members of the trade. Too much emphasis cannot be placed on the fact that one of the secrets of success in making trade analyses consists in getting the findings down in

[1] During the past two years the writer has been directing the analysis work of representatives from some twenty trades, both machine and hand, for the New York State Department of Vocational Education, and is therefore in a position to say that he knows that the needs of a large number of trades are fully met by these four captions.

black and white for the tradesmen to accept or reject. That the type of trade does not necessarily militate for or against the observance of this fundamental principle need not be stated.

In Part II, which follows, consideration is given to basic factors in curriculum making and to setting up a course of study consistent with the findings of the investigation and in accordance with the estimated needs of apprentices. Brief consideration is also given to the principles observed in the preparation of basic text material. The course of study submitted therein is believed to be adequate for meeting the needs of apprentices in evening school classes for a period of two years, where the sessions are two and one-half hours in length.

PART II

A COURSE OF STUDY

CHAPTER VII

USES MADE OF THE ANALYSIS

As has already been pointed out, making the analysis was only a means to more important ends, namely, setting up a course of study and preparing basic texts. The major questions involved in each of these procedures and the results obtained are set forth in succeeding pages.

A. Setting Up a Course of Study for Apprentices

1. *Basic Principles Involved.* It is a truism of modern educational theory that courses of study should be constructed to meet specific needs. This implies that the needs of those for whom the course is planned shall have been determined beforehand and set up as specific goals or objectives [1] to the attainment of which the course of study is presumably adequate. In the present instance, determining and setting up the objectives proved to be a comparatively easy matter, because of the availability of a comprehensive and accurate analysis of the trade. The following objectives were agreed upon: The apprentice should know the names of the various operations of the trade and how, why, and when to perform them; and he should be able to perform them with sufficient speed and accuracy. Obviously, a course of study for preparing offset pressmen apprentices should contain all the operations enumerated in the analysis together with the technical knowledge related thereto and should make provision for adequate practice in performing such operations.

This subject matter, that is, the operations just referred to, should also be arranged in the order in which the needs of apprentices will be most adequately and economically met if the course

[1] This idea has been repeatedly emphasized by such prominent men as Bobbitt, Bonser, Charters, Kitson and Rugg in the academic field and Allen, Bowman, Hawkins, Prosser, Selvidge, Smith, Wright, and others in the strictly industrial field. In a recent text the respective viewpoints of several contributors to industrial education theory are briefly indicated. (See *Industrial Education*, by Homer J. Smith, The Century Company.)

is to meet the acid test. To make this possible, due consideration must be given to (*a*) the actual or approximate learning-difficulty or ease-of-acquisition order of the various trade operations, and (*b*) the dependence which the less difficult trade operations have upon the more difficult ones because necessarily associated with them in trade jobs in such a way that production sequence requires learning the more difficult prior to the less difficult operations.

It must be remembered in this connection that trade operations usually, if not always, consist of several distinct skills rather than one, that each trade operation always involves two or more skills, and that this is usually true to a much greater extent of trade production jobs than of trade operations. In view of this and of other facts of equal import,[2] it is contended that there is no such thing as a scientifically accurate course of study in the sense that it meets in full every test that could be applied. Rather a course of study should be expected merely to indicate roughly the order or sequence of subject matter or instructional units.

In attempting to determine by accepted scientific methods the correct learning order or sequence of the various trade operations in this instance the following possible methods of procedure were considered:

1. Conduct a series of carefully controlled tests involving the satisfactory learning of all phases of the trade to the end that a graduated scale of learning difficulty, similar to that which obtains for spelling, might be discovered and set up.

2. Secure, by means of appropriate forms, the individual judgments of a sufficient number of expert tradesmen, whose responsibilities include the supervising of the work of apprentices in training, as to the relative difficulty experienced by apprentices in becoming proficient in the various trade operations.

3. Secure by means of appropriate forms, the individual judgments of selected foremen and assistant foremen, who have the direct supervision of apprentices in training, as to the relative difficulty experienced by such apprentices in learning how to perform the various trade operations.

4. Secure the individual judgments of selected, i.e., high-grade or promising apprentices not yet "out of their time," as to the relative difficulty experienced in (*a*) learning the various trade operations, and (*b*) in acquiring the necessary speed and accuracy.

5. Secure by means of appropriate forms, the individual judgments of selected tradesmen not responsible for apprentices in training, as to the relative difficultness of the various trade operations.

6. Tabulate the actual number of mistakes made during five-day periods by a number of tradesmen and apprentices under ordinary production conditions,

[2]See material on pp. 104-6.

attribute such mistakes to the proper deficiencies, and determine in this way the relative difficultness of the operations involved.

7. Have a trained analyst observe for an extended period—twelve to fifteen weeks should be adequate—tradesmen and apprentices engaged in production work for the purpose of becoming intimately acquainted with all phases of the trade, this to be followed by the preparation of a detailed analysis of all trade operations in accordance with the principles enumerated below.

a. Determine the inherent difficultness of each trade operation as revealed by its complexity:

(1) The number of distinct facts the learner must know in order to perform the operation.

(2) The nature of the facts which the learner must know as

(*a*) The purely denominative type, e.g., visual, auditory, touch and muscular, involving such things as what to do, what to use, how much to use, when to use, where to use, where to find, and so on.

(*b*) The purely "how to do" type, or the order of steps to be taken in performing the operation.

(*c*) The purely "why" type, or the reason for taking each step.

(3) The number of distinct skills, i.e., cycles of coördinated movements involved in doing an operation of the manual or muscular type; also those involved in making calculations or in forming judgments.

(4) The inherent difficultness of any manual or mental skill or of any part of either.

(5) The number of distinct movements which must be performed simultaneously in doing any part or phase of a manual operation.[3]

(6) The total number of distinct mental activities requiring coördination in performing any part of a problem or task.

(7) The number of distinct parts of the machine, tool, or material which demand attention at approximately the same time in an operation.

(8) The speed at which the operation as a whole or distinct phases of the operation must be performed. (Some cannot be performed in any other way than rapidly.)

(9) The nature of the product to be made, i.e., whether relatively simple or complicated.

b. The quality of workmanship demanded, i.e., the degree of precision, the degree of accuracy, and the degree of neatness.

c. The degree of visualization of the completed product necessitated.

d. The degree of obvious or apparent hazard involved in the way of bodily injury to the worker or to others, or of breakage or spoilage.

e. The quality of judgment required.

f. The amount or degree of speed that must be acquired eventually.

As Chart 4 (page 102) and the detailed analysis on page 105 indicate, methods 3 and 7 were seriously considered. The com-

[3] See Haynes' *Teaching Shop Work*, Ginn & Co., Chapter III, for a less elaborate expression of the same viewpoint.

CHART 4

SHOWING (x) COMPOSITE JUDGMENT OF SIX OFFSET PRESSMEN REGARDING RELATIVE DIFFICULTNESS OF THE VARIOUS OPERATIONS; (o) JUDGMENT OF THE INVESTIGATOR

	EASY TO LEARN			FAIRLY EASY			MEDIUM			FAIRLY HARD			HARD		
Marking the Plate				x				o							
Gumming Plate Before Washing It Out		x			o										
Washing Plate Out			x					o							
Cleaning Back of Plate			x		o										
Determining Amount of Packer Needed		x									o				
Putting Plate On								x	o						
Putting Blanket On				x	o										
Preparing Blanket to Put On				x				o							
Setting Form Rollers									x						o
Setting Top Damper									x						o
Setting Bottom Damper									x						o
Setting Damper Ductor									x					o	
Setting Ink Fountain Roller								o	x						
Setting Water Fountain Roller								o	x						
Setting Fountain Feed Screws								o	x						
Setting Side Guides							x	o							
Setting Front (Gripper) Guides					x						o				
Setting Stop Guides						x					o				
Setting Draw Guides					x			o							
Setting Feed Slides					x			o							
Setting Skeleton Wheels					x			o							
Setting Grippers on Impression Cylinder								x				o			
Setting Delivery Grippers								o	x						
Setting Automatic Feeder Devices									x						o
Setting Automatic Piler Devices							x	o							
Setting Pressure				x											o
Cleaning Composition Rollers	x							o							
Cleaning Grained Rollers	x										o				
Cleaning Riders	x		o												
Cleaning Drum Rollers	x		o												
Cleaning Sand or Grit Off Rollers	x					o									
Cleaning Sand or Grit Off Dampers	x					o									
Cleaning Grease Off Dampers	x		o												
Cleaning Dirt Off Form Rollers	x		o												
Cleaning Lint or Paper Off Rollers	x					o									
Cleaning Blanket	x					o									
Cleaning Plate			o	x											
Cleaning Cylinder Surfaces			o			x									
Cleaning Cylinder Bearers		x	o												
Cleaning Gripper Posts		x	o												
Cleaning Automatic Feeder Devices	x		o												
Cleaning Automatic Piler Devices				o	x										
Cleaning Ink Fountain				o	x										
Cleaning Water Fountain				o	x										
Cleaning Water Pail, Sponges, Etc		x		o											
Mixing Ink (Black) for Single-Color Job								x						o	
Mixing Ink (Blue) for Single-Color Job							x							o	
Mixing Ink (Red) for Single-Color Job						x								o	
Mixing Ink (First Color) 3-Color Job					x									o	
Mixing Ink (Fourth Color) 7-Color Job								x						o	
Stirring Ink in Fountain	x			o											
Changing Consistency of Ink					x							o			
Changing Shade of Ink					o			x							
Reducing Amount of Water Used	o					x									
Increasing Amount of Water Being Used	o			x											
Strengthening Water Mixture				x	o										
Weakening Water Mixture				x	o										
Inking Up for Run				x				o							
Starting and Stopping the Press	o				x										
Throwing Pressure On and Off	o			x											
Throwing Form Rollers On and Off	o	x													

CHART 4 (*Continued*)

	Easy to Learn			Fairly Easy			Medium			Fairly Hard			Hard		
Throwing Dampers On and Off	x	o													
Throwing Automatic Feeder On and Off		o						x							
Feeding Press						x		o							
Oiling Press				x	o										
Powdering Blanket	o			x											
Damping Plate	o	x													
Gumming Plate During Run				o	x										
Tending Press During Run								x							o
Checking Printed Sheet for Proper Shade								x							o
Checking Printed Sheet for Amount of Ink								x	o						
Checking Sheet for Consistency of Ink								x					o		
Checking Sheet for Finish of Design								x					o		
Patching Blanket					x					o					
Reducing Amount of Ink Being Used				x			o								
Removing Foreign Substances from Blanket				x			o								
Mending Surface of Blanket		x		o											
Restoring Resiliency of Blanket			x								o				
Hardening the Blanket					x						o				
Rubbing Creases Out of Blanket				x				o							
Rubbing Up Design on Plate												x	o		
Rubbing Down Design												x	o		
Polishing Out Parts of Design							x	o							
Removing Tint from Plate						x					o				
Removing Glazed Surface from Form Roller					x						o				
Removing (Stripping Off) Ink from Rollers				x				o							
Polishing Brass Fountain Roller				x				o							
Detecting Defects on Printed Sheet								x							o
Knowing Cause of Such Defects								x							o
Knowing What to Do to Remove Defects								x							o
Cleaning Fountain (Ink) Roller		o		x											
Cleaning Fountain (Water) Roller		o		x											
Adjusting Plate on Cylinder						o		x							
Adjusting Plate Cylinder						o		x							
Adjusting Dampers						o			x						
Adjusting Form Rollers						o				x					
Adjusting Damper Ductor						o			x						
Adjusting Fountain Feed Screws						o		x							
Adjusting Feed of Ink Fountain Roller						o		x							
Adjusting Cam for Delivery Grippers							o	x							
Adjusting Cam for Front Guides							o		x						
Adjusting Cam for Feeder Devices							o	x							
Adjusting Cam for Piler Devices							o		x						
Adjusting Blanket on Cylinder							o			x					
Adjusting Grippers on Impression Cylinder					o						x				
Adjusting Pressure								o	x						
Adjusting Feeder Devices				o					x						
Adjusting Piler Devices					o			x							
Adjusting Side Guides					o			x							
Adjusting Front Guides					o			x							
Adjusting Draw Guides					o	x									
Adjusting Stop Guides				o	x										
Adjusting Feed Slides					o		x								
Preparing Etching Solution					o			x							
Preparing Water Mixture					o			x							
Preparing Plate for Storeroom					o			x							
Preparing Blanket for Storeroom					o			x							
Placing Ink in Fountain		x					o								
Pouring Water in Fountain	o	x													
Placing Paper on Feeder Platform	o	x													
Taking Ink from Fountain	o	x													
Removing Plate from Cylinder		x	o												
Removing Blanket from Cylinder		x	o												
Removing Printed Sheets from Press		x	o												

posite of the returns from the limited use of method 3 appears in Chart 4. Though the number of cases is insufficient to meet the exacting demands of scientific method, the following conclusions seem justifiable.

The operations which these pressmen consider hardest for apprentices to learn satisfactorily are:

1. Setting the automatic feeder devices.
2. Etching (rubbing up) the design.
3. Thinning (rubbing down) the design.
4. Removing tint from plate.
5. Detecting defects on the printed sheet and dealing satisfactorily with them.
6. Adjusting impression cylinder grippers.

They also consider practically all the cleaning operations easy to learn. It is significant, if not conclusive, that the graph of the investigator's ratings made more than a month before the ratings were secured from the offset pressmen has the same general shape.[4]

The results of the attempt to determine the facts and skills involved in each trade operation as specified under method 7*a*, (1), (2), and (3) on page 101 will be found on page 107.

The skills listed in this detailed analysis were further analyzed for determining (*a*) the successive, and (*b*) the simultaneous movements involved, (*c*) the relative difficultness of each skill, (*d*) the relative amount of speed and the degree of precision required, (*e*) the amount of accuracy, (*f*) the degree of hazard involved, and (*g*) the quality of judgment necessitated (Form 8)[5]. The results of this laborious procedure tallied so closely with the writer's judgment as expressed in Chart 4 that it was deemed inadvisable to continue the analysis further.

An entirely different method was then made use of, namely, close coöperation with an offset pressman. The suggested course of study found on pages 115–131 is the outcome of this coöperation. In the conferences the investigator indicated the content of the proposed units of instruction and raised questions regarding the same. The pressman provided information regarding such matters as the time necessary for covering specific parts of the proposed course and the practicability of certain possible combinations from the standpoint of production. The question of emphasis also came in for consideration when setting up the course of study.

[4] See Chart 4, page 102. [5] See Form 8, page 105.

FORM 8

CHARACTERISTICS OF THE VARIOUS SKILLS INVOLVED IN THE SEVERAL TRADE OPERATIONS

NAME OF SKILL	NUMBER OF SUCCESSIVE MOVEMENTS INVOLVED	NUMBER OF SIMULTANEOUS MOVEMENTS INVOLVED	DIFFICULTNESS OF PERFORMANCE *a b c*	REQUIRED SPEED OF PERFORMANCE *a b c*	REQUIRED DEGREE OF PRECISION *a b c*	REQUIRED DEGREE OF ACCURACY *a b c*	AMOUNT OF HAZARD INVOLVED *a b c*	QUALITY OF JUDGMENT DEMANDED *a b c*

Explanatory Note: The letters *a*, *b*, *c*, signify presence of a characteristic in ascending order: *a*, meaning relatively little or none; *b*, a medium amount or degree; and *c*, relatively large or great.

An analysis of the problem revealed the necessity of giving attention to such factors as

1. The extent or degree to which mastery of the various operations, whether mental or manual, is essential to
   (*a*) Paving the way for the ready acquisition of more advanced or a higher order of skills by freeing the attention for these more advanced operations and by keeping the learner properly disposed toward the work at hand.
   (*b*) The actual acquisition of the higher skills.
2. The extent to which, as revealed by investigation, errors or mistakes take place in the performance of any specific operation or the carrying through of the movements constituting any specific skill, whether mental or manual.
3. The degree of familiarity with the operation as a whole or with any specific skill involved in its performance, whether mental or manual in character, that the learner possesses.
4. The extent to which opportunity for practice in the performance of a specific operation is provided the learner outside the school.
5. The inherent difficultness of the operation.
6. The extent to which the satisfactory performance of any specific operation, manual or mental, is essential to applying acquired knowledge. (The term "inherent coherency," or "sequence of operations," applies here.)
7. The quality or standard of workmanship required at different stages.
8. The rate of progress already attained by the learner as determined by his capacity and demonstrated ability to master different operations.
9. The specific objectives in mind, for example (*a*) checking up or testing the extent to which the learner has already mastered operations in the shop, and (*b*) giving particular attention to related knowledge and to the forming of correct judgments as contrasted with trade skills.

An attempt was made through the use of other forms to determine the degree to which apprentices were familiar with the various operations; but nothing worth while resulted therefrom. The writer is of the opinion that since the majority of the operations are relatively easy to learn, the question of familiarity is a matter of small concern. Partly because of this feeling and partly because of the nature of the trade, practically no attention was given, when setting up the course, to the question of how much and what kind of emphasis should be placed upon different operations. As the work progressed it was discovered that frequent repetition of certain important operations was a natural, in fact, an unpreventable feature of trade practice; and that, as a consequence, apparently little, if any, delay would be experienced by apprentices in the mastery of the trade if no consideration at all were given to the matter of emphasis when setting up the course.

2. *Statement and Classification of Facts and Skills Involved in Performing Simplest Type of Production Job.* A statement and classification of the facts and skills involved in performing the operations necessary in the simplest type of offset lithographing job are given in the following pages under the headings: Facts of Purely Denominative Character; Facts of Purely "How to Do" Character; Facts of Purely "Why" Character; and Skills.

STATEMENT AND CLASSIFICATION OF THE FACTS AND SKILLS

Operation	Facts of Purely Denominative Character	Facts of Purely "How To Do" Character	Facts of Purely "Why" Character	Skills
Gumming the Plate	1. Kind of care needed. 2. Materials: *a*. Gum. *b*. Sponge. *c*. Soft rag. *d*. Fan. 5. Needs to: *a*. Clean sponge. *b*. Spread gum evenly. *c*. Fan plate dry. 8. Know location of materials and tools.	1. How gum is kept. 2. How to place the plate. 3. How to put gum on. 4. How to use sponge. 5. How to use soft rag. 6. How to spread gum evenly. 7. How to fan plate dry.	1. Why gum is so kept. 2. Why gumming is necessary. 3. Why clean sponge is needed. 4. Why soft rag is required. 5. Why spread gum out evenly. 6. Why fan plate dry.	1. Handling the plate to get in place for gumming. 2. Pouring gum on. 3. Spreading gum on plate. 4. Evening up the gum on plate. 5. Fanning plate dry.
Washing Out the Plate	1. Kind of care necessary. 2. Materials: *a*. Asphaltum *b*. Soft rag. 3. Location of. 4. Amount of asphaltum to be used.	1. How to put asphaltum on plate. 2. How to use soft rag. 3. How to exercise required care. 4. How to know when job has been done satisfactorily. 5. How to use second rag.	1. Why washing out is necessary. 2. Why soft rag is needed. 3. Why exercise specified care. 4. Why use asphaltum. 5. Why use second soft rag.	1. Pouring asphaltum on. 2. Washing with rag. 3. Drying with second rag.
Cleaning Back of Plate	1. Kind of care necessary. 2. Materials: *a*. Kerosene. *b*. Rag. *c*. Knife or equivalent. 5. Location of. 6. Need for using palm of hand. 7. Amount of materials required.	1. How to exercise required care. 2. How to use materials and tools. 5. How to turn plate over. 6. How to use palm of hand.	1. Why exercise specified care. 2. Why clean back of plate. 3. Why use kerosene. 4. Why rub with palm of hand.	1. Pouring liquid on. 2. Washing plate with rag. 3. Rubbing plate with palm of hand. 4. Turning plate over.

STATEMENT AND CLASSIFICATION OF THE FACTS AND SKILLS (*Continued*)

OPERATION	FACTS OF PURELY DENOMINATIVE CHARACTER	FACTS OF PURELY "HOW TO DO" CHARACTER	FACTS OF PURELY "WHY" CHARACTER	SKILLS
Putting Plate on	1. Kind of care needed. 2. Materials and tools: *a*. Clamps. *b*. Set screws. *c*. Cylinder. *d*. Wrench. 6. Need for cylinder to be in position.	1. How to get cylinder in position. 2. How to handle plate. 3. How to tighten the clamps and screws. 4. How to exercise required care. 5. How to revolve cylinder.	1. Why get cylinder in position. 2. Why exercise the specified care. 3. Why tighten clamps and screws in certain way. 4. Why revolve cylinder.	1. Placing the plate in position. 2. Putting plate in clamps. 3. Tightening clamps and set screws. 4. Revolving cylinder.
Determining Amount of Packer Needed	1. Kind of care required. 2. Materials and tools: *a*. "Mike." *b*. Straightedge. *c*. Paper sheets. *d*. Plate. 6. What cut-out is. 7. What relation of cylinder and cylinder surfaces is. 8. Amount of overdiameter required. 9. Overdiameters must be same on the two cylinders. 10. The right time to read the "mike."	1. How to exercise required care. 2. How the "mike" is used. 3. How straightedge is used. 4. How to read the micrometer. 5. How to determine the amount of cut-out. 6. How to determine the amount of packer needed. 7. How to tell when pressure is correct.	1. Why specified care is necessary. 2. Why it is necessary to take each of steps indicated in "How to do" column. 6. Why overdiameters must be equal. 7. Why "mike" must be read when on the plate or paper.	1. Finding amount of cut-out. 2. Manipulating the "mike." 3. Reading the "mike." 4. Using straightedge.
Putting the Blanket On	1. Kind of care needed. 2. Materials and tools: *a*. Wrenches. *b*. Screw driver. 3. Position of cylinder. 4. Which end to put in first. 5. How much to tighten. 6. Need to revolve cylinder.	1. How to exercise required care. 2. How to handle blanket. 3. How to get cylinder in position and arrange packer. 4. How to hold the blanket. 5. How to tighten blanket. 6. How to test blanket after tightening. 7. How to revolve cylinder.	1. Why observe specified care. 2. Why get cylinder in position. 3. Why arrange the packer in a certain way. 4. Why tighten the blanket in a certain way.	1. Carrying blanket to press. 2. Putting rod in socket. 3. Placing the packer. 4. Tightening the blanket. 5. Holding blanket while revolving cylinder.

STATEMENT AND CLASSIFICATION OF THE FACTS AND SKILLS (*Continued*)

OPERATION	FACTS OF PURELY DENOMINATIVE CHARACTER	FACTS OF PURELY "HOW TO DO" CHARACTER	FACTS OF PURELY "WHY" CHARACTER	SKILLS
Setting the Dampers	1. Kind of care needed. 2. Need for accuracy. 3. Materials and tools needed: *a*. Paper slip. *b*. Wrench. 4. Amount of pressure required.	1. How to exercise required care. 2. How to be accurate. 3. How to use paper slip, etc., and wrench. 4. How to determine required pressure.	1. Why exercise specified care. 2. Why be accurate. 3. Why use paper slip and wrench.	1. Putting paper slip in place. 2. Loosening set screws. 3. Tightening set screws. 4. Holding in position while tightening.
Setting Damper Ductor	1. Kind of care needed. 2. Need for accuracy. 3. Tools and materials needed: *a*. Wrench. *b*. Paper slip. 4. Amount of pressure required.	1. How to exercise required care. 2. How to be accurate. 3. How to use paper slip and wrench. 5. How to determine required pressure.	1. Why exercise specified care. 2. Why be accurate. 3. Why use paper slip.	1. Putting paper slip in place. 2. Loosening and tightening screws. 4. Holding in position.
Mixing Black Ink	1. Kind of care needed. 2. Need for considering *a*. Job demands. *b*. Nature of body color. 4. Body color factors (materials). 6. Tools needed. 8. Materials needed. 10. Service expected from each ingredient.	1. How to exercise required care. 2. How to estimate or determine job demands and nature of body color. 4. How to use needed materials. 6. How to use tools.	1. Why exercise care specified. 2. Why consider *a*. Job demands. *b*. Content of body color. 4. Why use each of different materials. 6. Why use each of tools in certain way. 7. Why expect certain type of service from each ingredient.	1. Securing needed ingredients. 2. Mixing ingredients properly.
Preparing the Water Mixture	1. Kind of care needed. 2. Materials and tools: *a*. Water. *b*. Pail. *c*. Graduated vessel. *d*. Chromic acid. 7. Amounts of each. Where to secure each.	1. How to exercise required care. 2. How to handle various materials. 8. How to read scale for measuring purposes.	1. Why exercise the specified care. 2. Why handle each of materials and tools as specified. 8. Why prepare water mixture. 11. Why use specific amounts of each ingredient.	1. Securing needed ingredients. 2. Measuring proper amounts. 3. Mixing ingredients.

STATEMENT AND CLASSIFICATION OF THE FACTS AND SKILLS (*Continued*)

OPERATION	FACTS OF PURELY DENOMINATIVE CHARACTER	FACTS OF PURELY "HOW TO DO" CHARACTER	FACTS OF PURELY "WHY" CHARACTER	SKILLS
Placing Ink in Fountain	1. Kind of care needed. 2. Tools and materials: *a.* Palette knife. *b.* Broad knife. 4. Amount to carry. 5. Need to distribute in fountain. 6. Need to move rapidly.	1. How to exercise required care. 2. How to use each of knives. 4. How to determine right amount. 5. How to distribute in fountain.	1. Why take specified care. 2. Why use each of two knives. 3. Why carry one amount rather than another. 4. Why distribute in fountain.	1. Placing ink on knife. 2. Carrying ink to fountain. 3. Removing ink from knife. 4. Distributing ink.
Putting Water Mixture in Fountain	1. Kind of care necessary. 2. Tools needed. 3. Amount to be poured in.	1. How to exercise needed care. 2. How to use tools. 3. How to ascertain required amount.	1. Why put water in fountain. 2. Why limit the amount poured in at one time.	1. Carrying to fountain. 2. Pouring into fountain.
Placing Paper on Platform	1. Kind of care needed. 2. Where to place. 3. Kind of treatment needed before putting on. 5. Need to square-up after putting on platform.	1. How to exercise needed care. 2. How to treat before placing on platform. 5. How to handle in placing on platform. 6. How to square up.	1. Why take specific care. 2. Why treat before placing on platform. 3. Why handle in specified way. 4. Why square up.	1. Treating before placing on platform. 2. Placing on. 3. Squaring up after placing on.
Setting Feeder Devices (There are 8 or more of such devices)	1. Kind of care needed. 2. Names of different devices. 9. Kind of service expected from each. 15. Tools needed 16. What to loosen. 22. What to shift 28. Where to set.	1. How to exercise specified care. 2. How to loosen parts of devices. 9. How to shift parts. 16. How to set devices for good service. 22–29. How to tighten parts.	1. Why set devices. 2. Why be careful about it. 3. Why shifting is occasionally necessary.	1. Loosening each device. 9. Shifting each of them as needed. 17. Setting each of them.
Setting Side Guide	1. Kind of care needed. 2. Names of parts of guide involved. 5. Tools needed. 8. Where to set.	1. How to exercise required care. 2. How to use tools. 3. How to ascertain where to set guide. 6. How to set.	1. Why exercise specified care. 2. Why set side guide at all. 3. Why measure distance on plate in order to find where to set.	1. Finding where to set. 2. Loosening. 3. Shifting. 4. Tightening.

STATEMENT AND CLASSIFICATION OF THE FACTS AND SKILLS (*Continued*)

OPERATION	FACTS OF PURELY DENOMINATIVE CHARACTER	FACTS OF PURELY "HOW TO DO" CHARACTER	FACTS OF PURELY "WHY" CHARACTER	SKILLS
Setting Fountain Feed Screws	1. Kind of care needed. 2. Amount to turn screws. 3. How screws work. 4. What screws control.	1. How to exercise required care. 2. How to shift the screws.	1. Why exercise specified care. 2. Why setting is needed. 3. Why shift small amounts.	1. Shifting feed screws.
Inking in for Run	1. Kind of care needed. 2. Names of mechanisms involved.—(levers or control buttons). 7. Number of revolutions required. 8. When different mechanisms are to be thrown on.	1. How to exercise required care. 2. How to throw different parts of press on. 7. How to know when plate is ready for first sheet.	1. Why exercise specified care. 2. Why observe specific order in putting parts of press into operation. 6. Why not start sheet through when press starts.	1. Starting press. 2. Throwing on dampers. 3. Throwing on form-rollers. 4. Putting on pressure.
Setting the Pressure	1. Kind of care needed. 2. Names of parts involved: *a*. Scale. *b*. Lock nut. *c*. Set screw. 5. Amount of shift necessary. 6. Relation of pressure to thickness of sheet.	1. How to exercise required care. 2. How to read scale. 3. How to manipulate mechanism. 4. How to determine amount to shift or where to set pressure.	1. Why exercise specified care. 2. Why set the pressure. 3. Why determine thickness of sheet.	1. Finding where to set pressure. 2. Making necessary calculations. 3. Making necessary adjustments.
Pulling an Impression	1. Kind of care required. *a*. Paper is O. K. *b*. Feeder is O. K. *c*. Press is started before dampers and form-rollers are on. *d*. Feeder is thrown on after inking in is done.	1. How to exercise required care. *a*. See that paper and feeder are O. K. *b*. Observe correct order of starting parts of press. 4. How to start various parts of press.	1. Why exercise care specified. 2. Why observe specific order of starting different parts of press. 3. Why pull an impression.	1. Start press. 2. Throw dampers on. 3. Throw form-rollers on. 4. Start feeder.

STATEMENT AND CLASSIFICATION OF THE FACTS AND SKILLS (*Continued*)

OPERATION	FACTS OF PURELY DENOMINATIVE CHARACTER	FACTS OF PURELY "HOW TO DO" CHARACTER	FACTS OF PURELY "WHY" CHARACTER	SKILLS
Comparing with Proof	1. Kind of care needed. 2. What to look for in making comparison. *a*. Correct tone. *b*. Correct finish. *c*. Correct consistency. *d*. Correct design. 6. Order to observe in making comparison.	1. How to exercise required care. 3. How to look for each of specified means of comparison. 6. How to handle impression in making the comparison.	1. Why exercise specified care. 2. Why observe any specific order or technique when making the comparison. 3. Why compare with proof.	1. Handling sheet and proof while making comparison.
Making Needed Adjustments (*a*) For Pressure	1. Kind of care needed. 2. Which way to shift. 3. How much to shift. 4. Tools, if any, needed.	1. How to exercise required care. 2. How to find out which way to shift. 3. How to make shift.	1. Why exercise specified care. 2. Why adjust for pressure.	1. Making needed shift or adjustment. *a*. Loosening. *b*. Shifting. *c*. Tightening.
(*b*) For Ink Consistency	1. Kind of care needed. 2. What corrections are needed. 3. What ingredients are needed to make correction. 4. Amounts of each.	1. How to exercise needed care. 2. How to find what corrections are needed. 3. How to know what ingredients to use.	1. Why exercise specified care.	1. Secure needed ingredients. 2. Place in ink mixture. 3. Stir into ink mixture.
(*c*) For Amount of Ink being Distributed	1. Kind of care needed. 2. What correction is necessary. 3. Tools needed. 4. Amount of adjustment needed.	1. How to exercise required care. 2. How to ascertain needed corrections. 3. How to make needed corrections.	1. Why exercise specified care. 2. Why adjust for this purpose.	1. Reduce amount of ink getting to rollers. 2. Increase the amount.
(*d*) For Position on Sheet	1. Kind of care needed. 2. What correction is needed. 3. Amount of correction needed. 4. Tools needed. 5. Where to make adjustment.	1. How to exercise required care. 2. How to find out needed correction. 3. How to make needed adjustment	1. Why exercise specified care. 2. Why adjustment is needed.	1. Measuring amount of adjustment needed. 2. Making the adjustment.

STATEMENT AND CLASSIFICATION OF THE FACTS AND SKILLS (*Continued*)

OPERATION	FACTS OF PURELY DENOMINATIVE CHARACTER	FACTS OF PURELY "HOW TO DO" CHARACTER	FACTS OF PURELY "WHY" CHARACTER	SKILLS
Adjusting Piler Devices	1. Kind of care needed. 2. Kind of adjustment needed. 3. Amount needed. 4. Tools needed. 5. Parts of mechanism to be shifted.	1. How to exercise required care. 2. How to determine adjustment needed. 3. How to use tools in making adjustments.	1. Why exercise specified care. 2. Why adjust piler devices.	1. Securing tools. 2. Making needed adjustments (there will be from one to six such adjustments to make.)
Adjusting Feeder Devices	1. Kind of care needed. 2. Kind of adjustment needed. 3. Amount of adjustment necessary. 4. Tools needed.	1. How to exercise required care. 2. How to determine needed adjustment. 3. How to use tools in making the adjustments.	1. Why exercise specified care. 2. Why make such adjustments.	1. Finding amount of needed adjustment. 2. Making the adjustments which may be few or many.
Cleaning Water Pail, Sponges and Acid Bottle	1. Kind of care necessary. 2. Tools and materials needed: *a*. Hot water. *b*. Stiff brush. 4. Amount of water required. 5. How often needed. 6. Where to perform operation.	1. How to exercise needed care. 2. How to clean various articles.	1. Why exercise specified care. 2. Why clean the different articles. 3. Why clean at stated periods.	1. Scrub pail. 2. Wring out sponge.
Cleaning Water Fountain	1. Kind of care necessary. 2. Tools and materials needed: *a*. Hot water. *b*. Brush or rag. 4. Where perform work.	1. How to exercise needed care. 2. How to use tools and materials to perform operation.	1. Why exercise specified care. 2. Why clean water fountain. 3. Why use hot water and brush.	1. Scrub the fountain. 2. Remove from press. 3. Replace on press.
Taking Ink from Fountain	1. Kind of care necessary. 2. Tools needed. *a*. Knife.	1. How to exercise needed care. 2. How to use each of tools.	1. Why exercise specified care. 2. Why take ink from fountain.	1. Using knife, rag, etc.
Cleaning Ink Fountain	1. Kind of care necessary. 2. Tools and materials. *a*. Rag. *b*. Gasoline. 4. Amount needed.	1. How to exercise needed care. 2. How to use rag and gasoline.	1. Why exercise needed care. 2. Why use gasoline.	1. Using rag.

STATEMENT AND CLASSIFICATION OF THE FACTS AND SKILLS (*Continued*)

OPERATION	FACTS OF PURELY DENOMINATIVE CHARACTER	FACTS OF PURELY "HOW TO DO" CHARACTER	FACTS OF PURELY "WHY" CHARACTER	SKILLS
Cleaning Form Rollers	1. Kind of care necessary. 2. Tools and materials. *a*. Rags. *b*. Gasoline. 5. Amount to use. 6. Where do cleaning.	1. How to exercise needed care. 2. How to use each of tools and materials.	1. Why exercise specified care. 2. Why clean form-rollers. 5. Why use gasoline and rags.	1. Using rags.
or Grained Rollers	1. Kind of care necessary. 2. Tools and materials. *a*. Scraper. *b*. Sandpaper. *c*. Kerosene. 5. Amount needed.	1. How to exercise needed care. 2. How to use each of tools, materials, etc.	1. Why exercise specified care. 2. Why use scraper. 3. Why use kerosene. 4. Why clean rollers.	1. Using scraper. 2. Using sandpaper.

As has been stated, the suggested course of study is the product of numerous conferences between an expert offset pressman [6] and the investigator. It is not to be assumed, however, that, because the pressman represented trade practice in these conferences, the writer's contact with the trade when making the analysis proper and the later detailed analysis of the operations involved in the simplest production job was of no consequence. To the contrary, it is believed that these contacts were an invaluable aid, even though the evidence to support this is limited. The indicated preparation is given for each unit because no professionally trained instructor-pressmen are at present available.

When setting up the course, the needs of a specific type of apprentice were kept in mind, namely, those who work regularly on or around offset presses in the daytime and attend school two and a half hours per evening twice a week. It was necessary, of course, to specify the content for different units; but this does not necessarily imply that each unit is to be covered in a single class session or that a portion of the content of any one unit should not be covered again at the next session. Decision as to these matters must be left to the instructor in charge. The principles

[6] The writer is deeply obligated to Adolph Greenstein for his ready and efficient coöperation in this connection.

which governed the selection of content for the successive units were:

1. In trade practice, certain operations are more basic than others in that they are more frequently performed and they always precede others.
2. The learner can assimilate only a limited amount of new information at a session.
3. The learner should be provided the opportunity to use his newly acquired knowledge at the same class session.
4. Mastery in any field necessitates adequate practice.

3. *Suggested Course of Study for Training Offset Pressmen.* The suggested course of study for training offset pressmen apprentices follows. The course is divided into two years.

First Year

The major objective of the first year's work is to acquaint the apprentice with all of the operations involved in handling the press satisfactorily on one-color (black) jobs. This objective may be further divided as follows:

a. To see that apprentices acquire ease and reasonable speed in performing the operations most frequently performed in running single-color offset presses, e. g., oiling up, gumming up, washing up, cleaning and powdering the blanket, adjusting the mechanisms of the feeder and delivery, and placing paper on piler.

b. To see that they know how to wash out the plate and put it on the cylinder.

c. To see that they acquire some facility in mixing colors, in preparing the right kind of damping solution, in getting the lay, and in putting on and removing the blanket.

d. To see that they make headway in acquiring such trade habits as accuracy, cleanliness, observing safety regulations, etc.

e. To acquaint them with the causes of the simpler types of lithographing difficulties and how they may be remedied.

I. Purpose: (1) To teach basic safety measures. (2) To teach how to prepare plate for cylinder and to put it on O.K.; also how to wash and powder blanket. (3) To show how to wash up and get press ready to stand idle.

Content	*Required Preparation*	*References* *
1. Major safety considerations.	Press in O. K. condition.	Unit I. Pp. 8, 10, 13, 18, and 61.
2. Clean back of plate.	Plate known to be O. K.	
3. Re-gum plate.	Plate requires no packing.	
4. Wash out plate.	Feeder already loaded. (Medium-offset stock).	
5. Put plate on (no packing required).	Feeder and piler devices properly adjusted.	
6. Pull impression (instructor will do all necessary work connected with this).	Ink already mixed or will be mixed for job by instructor.	
7. Clean blanket and printing cylinders.		
8. Gum plate.		
9. Wash up.		

II. Purpose: (1) To teach how to set form rollers.

Content	*Required Preparation*	*References*
1. Set form rollers.	Press in same condition as for last unit except that form rollers have been put out of adjustment.	Unit I. Pp. 21, 61.
2. Wash plate off.	Ink for last job O. K. for this unit.	
3. Pull impression. (Instructor will ink up and perform other necessary work connected with pulling impression.)		

III. Purpose: (1) To teach how to set damping, ductor, and water rollers. (2) To provide practice at old operations.

Content	*Required Preparation*	*References*
1. Set damping rollers.	Press as in last unit except that damping rollers, ductor roller, and water roller have been put out of adjustment.	Unit I. P. 60.
2. Set ductor roller.	Ink for last unit to be used.	
3. Set fountain roller.		
4. Wash plate off.		
5. Pull impression. (Instructor to do this work.)		
6. Wash up.		
7. Gum plate.		

IV. Purpose: (1) To teach how to put blanket on and to stretch it properly. (2) To provide practice at old operations.

Content	*Required Preparation*	*References*
1. Put blanket on (packing required).	Press as in last unit except that blanket has been removed.	Unit I. P. 19. Unit IV. P. 13.
2. Stretch blanket.	Blanket known to be O.K.	
3. Re-gum plate.	Instructor knows amount of packer needed.	
4. Wash plate off.		
5. Pull impression.		
6. Wash up.		
7. Gum plate.		

* The seven units comprising Group I of *Basic Texts for Apprentices in Lithography* have the following titles: (1) Operating the Press; (2) Detecting and Overcoming Difficulties; 3) Offset Inks; (4) Offset Blankets; (5) Offset Plates; (6) Offset Papers; (7) Offset Rollers.

V. Purpose: (1) To teach how to set pressure. (2) To teach how to mix color and to place same in fountain. (3) To provide practice at old operations.

Content	*Required Preparation*	*References*
1. Set pressure between blanket.	Press as in last unit.	Unit I. Pp. 50, 54, 55.
2. Mix ink for run.		
3. Place ink in fountain.		
4. Wash plate off.		
5. Pull impression.		
6. Gum plate.		
7. Wash up.		

VI–VII. Purpose: (1) To teach how to perform all operations responsible for getting sheet down to the stop or gripper guides.

Content	*Required Preparation*	*References*
1. Pile sheets on feeder.	Remove paper.	Unit I. Pp. 41, 43, 45.
2. Set feeder devices.	Press as in last unit except for plate.	
3. Set piler devices (air, suction, etc.).	The use of a different size of sheet necessitates readjustment of various devices.	
4. Re-gum plate.	New paper (Bond), new plate (letterhead work).	
5. Wash plate off.		
6. Pull impression.		
7. Wash up.		
8. Gum plate.		

VIII. Purpose: (1) To teach how to get sheet to feed and deliver satisfactorily.

Content	*Required Preparation*	*References*
1. Set side guide.	Press in O. K. condition.	Unit I. Pp. 21, 22, 45.
2. Set gripper guides.	No ink needed because no lithographing is done.	
3. Set the joggers.		
4. Run trial sheets.		
5. Adjust if necessary.		

IX. Purpose: (1) To get the lay O. K. for run.

Content	*Required Preparation*	*References*
1. Mix color.	Press in O. K. condition for running but not for printing satisfactorily on sheet.	Unit I. P. 65.
2. Put ink in fountain.		
3. Pull impression.		
4. Examine sheet for location of print.		
5. Shift plate if needed.		
6. Pull impression.		
7. Jump cylinders, if needed.		
8. Pull impression.		
9. Adjust the side guide, if necessary.		
10. Adjust front guide if necessary.		
11. Gum up.		
12. Wash up.		

X. Purpose: (1) To test ability to prepare and put plate on (no packing required). (2) To test ability to perform all operations connected with feeding and delivering the sheet satisfactorily.

Content	*Required Preparation*	*References*
	Feeder devices are out of adjustment. Trial sheets made available. No impressions need be pulled.	

XI. Purpose: (1) To test ability. (2) To mix color. (3) To ink up. (4) To pull an impression. (5) To pass on quality of impression.

Content	*Required Preparation*	*References*
	Press O. K. for running, except that plate is off. Plate is known to be O. K. (same as first plate) and not to require packing. Feeder is loaded and set.	

XII. Purpose: (1) To test ability to perform operations involved in getting the lay.

Content	*Required Preparation*	*References*
	Take plate off. Everything else O. K. as at end of last unit. Feeder has been reloaded.	

XIII. Purpose: (1) To emphasize necessity for cleanliness. (2) To provide chance to observe cleanliness. (3) To determine amount of packing needed for plate.

Content	*Required Preparation*	*References*
1. Clean pails. 2. Clean sponges. 3. Clean gumming rag. 4. Clean back of plate. 5. Wash out plate. 6. Put plate on cylinder (packing required). 7. Mix color. 8. Pull impression. 9. Inspect impression for (plate) pressure. 10. Make adjustments, if necessary.	Press is O. K. for running as soon as plate No. 3 is put on. Plate (label work) is known to be O. K. and amount of packing required is known to instructor. Paper (M–F or light offset) on feeder.	Units 1, V. Pp. 17, 19.

XIV. Purpose: (1) To provide practice in putting blanket on when packing is required. (2) To determine amount of packing necessary.

Content	*Required Preparation*	*References*
1. Wash plate out. 2. Put blanket on. 3. Stretch blanket.	Press O. K. for run, except that used blanket must be put on.	Unit I. Pp. 14, 19. Unit IV. Pp.

Content	*Required Preparation*	*References*
4. Pull impression for blanket pressure. 5. Correct packing, if necessary. 6. Pull impression.	Color already mixed.	9, 10, 13, 14.

XV. Purpose: (1) To set pressure—printing (impression) cylinder.

Content	*Required Preparation*	*References*
1. Put plate under asphalt. 2. Pull impression (defective). 3. Correct pressure on printing (impression) cylinder. 4. Pull impression. 5. Make necessary adjustments.	Press O. K., except that pressure is off on impression cylinders.	Units I, V. P. 50.

XVI. Purpose: (1) To mix color. (2) To prepare damping solution. (3) To ink up for run.

Content	*Required Preparation*	*References*
1. Put plate under asphaltum. 2. Mix color. 3. Set ink fountain. 4. Ink up for run. 5. Prepare damping solution. 6. Pull impression.	Press O. K. for running.	Unit I. Pp. 56, 57, 58.

XVII. Purpose: (1) To test ability to get the lay.

Content	*Required Preparation*	*References*
1. Wash plate out. 2. Mix color. 3. Pull impression. 4. Make necessary adjustments. 5. Pull impression. 6. Adjust side and front guides. 7. Pull impression.	Press O. K. but lay has not been determined.	Unit I. P. 65.

XVIII. Purpose: (1) To test ability to put plate and blanket on O. K. when packing is required.

Content	*Required Preparation*	*References*
1. Take plate off. 2. Wash plate out. 3. Prepare plate and put on cylinder (packer required). 4. Put blanket on. 5. Pull impression. 6. Make adjustments.	Press O. K. except plate No. 5 (label or pen job) and blanket are to be put on.	Unit I. Pp. 18, 19.

XIX. Purpose: (1) To provide information regarding structure of blankets and how to handle them.

Content	*Required Preparation*	*References*
Special lecture on offset blankets or a visit to a manufacturing plant.	If lecture method is employed, pieces of blanket at various stages of development should be exhibited. Blanket defects not to be touched upon.	

XX. Purpose: (1) To test students' grasp of information given out at last session. (2) To clear up any misunderstandings.

Content	*Required Preparation*	*References*
1. Oral quiz covering points mentioned at last session. Follow by having pupils prepare new blanket for cylinder, put it on, massage out, and pull impression.	Press O. K. with exception of blanket cylinder which is naked. New blanket necessary.	Unit I. P. 19. Unit IV.

XXI. Purpose: (1) To teach how to clean cylinders and bearers. (2) To provide practice at operations already covered.

Content	*Required Preparation*	*References*
1. Take plate off. 2. Clean cylinder and bearers. 3. Put plate on. 4. Pull impressions. 5. Check for pressure and for cleanliness of open parts of sheets.	New plate (No. 6) to be like No. 1. Feeder to be loaded with sheets printed on one side from plate No. 1. Everything else in order for running.	Unit I. Pp. 16, 32.

XXII. Purpose: (1) To teach how to change and clean side guide. (2) To provide practice.

Content	*Required Preparation*	*References*
1. Remove side guide. 2. Clean side guide. 3. Place new side guide on the other side. 4. Adjust cam or bar. 5. Pull impression. 6. Adjust to secure lay.	Everything same as at last session.	Unit I. P. 27.

XXIII. Purpose: (1) To teach how to sew and adjust tapes, also to set cylinder brush. (2) To provide practice.

Content	*Required Preparation*	*References*
1. Measure and cut new tapes. 2. Sew and adjust tapes. 3. Adjust cylinder brush.	Raise cylinder brush. Everything else O. K.	

Content	*Required Preparation*	*References*
4. Pull impressions. 5. Check and adjust, if necessary. 6. Run several trial sheets.		

XXIV. Purpose: (1) To teach how to mix color for large solids. (2) To provide practice.

Content	*Required Preparation*	*References*
1. Take plate off. 2. Put new plate on. 3. Mix color. 4. Get the lay. 5. Pull impression. 6. Check color for consistency.	Plate No. 7 (plain solids). Fairly good offset paper to be loaded on the piler.	Unit I. Pp. 63–86.

XXV. Purpose: (1) To teach how to detect and overcome specific types of difficulties: (*a*) blanket depression, (*b*) loose blanket.

Content	*Required Preparation*	*References*
1. Remove blanket. 2. Put on old blanket. 3. Pull impression. 4. Check impression for defect due to dent. 5. Patch blanket. 6. Pull impression. 7. Check for defect due to loose blanket. 8. Adjust (tighten) blanket. 9. Pull impression.	Old blanket with dent in it to be used. Plate same as XXIV. Feeder loaded. See that blanket is not stretched enough after patching.	Unit I. P. 77.

XXVI. Purpose: (1) To teach how to wash damper rollers and clean skeleton wheels. (2) To provide practice.

Content	*Required Preparation*	*References*
1. Take dampers out and wash. 2. Clean skeleton wheels. 3. Replace dampers and set them.	Have benzine or ether for dampers.	Unit I. Pp. 16, 39, 95, 96.

XXVII. Purpose: (1) To teach how to change suckers. (2) To test dampers. (3) To provide practice.

Content	*Required Preparation*	*References*
1. Take plate off. 2. Clean cylinder and bearers. 3. Put new plate on. 4. Load into the piler. 5. Change suckers. 6. Check up on suckers. 7. Pull impression.	1. Plate No. 8 (half tone). 2. Good offset paper to be used. 3. Everything else O. K.	Unit I. P. 107.

XXVIII. Purpose: (1) To teach how to adjust the separating devices and the forwarding unit. (2) To provide practice.

Content	*Required Preparation*	*References*
1. Adjust separating devices. 2. Adjust forwarding unit. 3. Check and adjust again if necessary. Pull impression.	Same plate as XXVII. Feeder to be loaded.	Unit I. Pp. 34, 43.

XXIX. Purpose: (1) To teach what constitutes quality in impressions and to provide practice in detecting evidences of quality and in changing color so as to produce quality.

Content	*Required Preparation*	*References*
1. Wash plate out (asphalt). 2. Mix color. 3. Pull impression. 4. Get the lay. 5. Check the quality. 6. Change color as needed. 7. Pull impression. 8. Check for quality.	Everything same as in previous unit. Instructor to change consistency of color several times.	Unit I. Pp. 54, 62.

XXX, XXXI, XXXII. Purpose: (1) To test ability to clean cylinders and bearers. (2) To test ability to remove side guide. (3) To test ability to place side guide on other side of press. (4) To test ability to run trial sheets and make necessary adjustments. (5) To mix color. (6) To pull satisfactory impression. (7) To test ability to discover defect due to blanket depression. (8) To test ability to patch blanket properly. (9) To test ability to put blanket on cylinder.

XXXIII. Lecture on plates..... Unit V

XXXIV. Oral quiz on plates, etc..... Unit V

XXXV. Purpose: (1) To teach how to set chokers and stop guides on Harris (or) to set calipers and sheet straighteners on Dexter. (2) To provide practice.

Content	*Required Preparation*	*References*
1. Set chokers or calipers. 2. Check and adjust. 3. Set stop guides or sheet straighteners. 4. Check and adjust. 5. Run trial sheets.	Everything same as previous lesson except that heavier stock is to be used.	Unit I. P. 64.

XXXVI. Purpose: (1) To teach how to adjust: (*a*) front or gripper guides on Dexter; (*b*) trip locks and pendulums on Dexter; (*c*) feed-ups on Harris; (2) To provide practice.

Content	*Required Preparation*	*References*
1. Adjust front guides. 2. Adjust trip blocks and pendulums. 3. Adjust feed-ups. 4. Check and adjust. 5. Adjust pressure. 6. Pull impression.	Everything O. K. as left in last session.	Unit I. P. 22.

XXXVII. Purpose: (1) To teach how to mix color for different kinds of paper. (2) To provide practice.

Content	*Required Preparation*	*References*
1. Wash plate out while on cylinder. 2. Mix color. 3. Ink up. 4. Pull impression. 5. Check and adjust (change) color. 6. Pull impression. 7. Mix color for different kind of paper. 8. Pull impression. 9. Check and adjust. 10. Pull impression. 11. Take plate off.	Same plate. Use two different kinds of paper. (*a*) Offset. (*b*) Coated.	

XXXVIII–XXXIX. Purpose: To teach color mixing for (*a*) different types of job, (*b*) different kinds of paper, (*c*) to provide practice.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers. 2. Wash plate out. 3. Put plate on. 4. Mix color for one kind of paper. 5. Get the lay. 6. Pull quality impression. 7. Wash plate out (asphalt). 8. Mix color for different paper. 9. Pull impression. 10. Check and adjust color. 11. Pull quality impression.	Plate No. 9 consisting of a combination of half tone with solids. Use three different kinds of paper. (*a*) Heavy offset. (*b*) M. F. (*c*) Coated.	Unit I. P. 16.

XL, XLI, XLII. Purpose: (1) To test ability to set choker and stop guides. (2) To test ability to set calipers and sheet-straighteners. (3) To test ability to set gripper guides. (4) To test ability to set trip blocks, pendulums, etc. (5) To test ability to set feed-ups. (6) To test ability to mix color for different types of jobs and for different kinds of paper.

Second Year

The objectives of the second year are as follows:

a. To prepare apprentices to handle the press satisfactorily on multi-colored jobs.

b. To cover the mechanical operations not covered during the first year.

c. To provide information on color mixing with regard to correct shade, proper consistency, degree of permanency, and suitable drying qualities for different kinds of paper and in different atmospheres.

d. To acquaint apprentices with the lithographic defects commonly met with in the pressrooms together with their causes and remedies.

I. Purpose: (1) To refresh the apprentice's memory regarding important aspects of press operation, especially those pertaining to safety measures both general and specific.

Content	*Required Preparation*	*References*
1. Review of first year's work covering the following: (*a*) General safety measures. (*b*) Proper oiling. (*c*) Care in putting plate on, throwing on the pressure and handling rollers. (*d*) Care of rubber blankets. (*e*) Cleanliness.		

II–III. Purpose: (1) To teach how to place side-guide mark on plate. (2) To teach how to mix black ink for label job on M. F. stock. (3) To provide practice.

Content	*Required Preparation*	*References*
A		
1. Clean back of plate. 2. Re-gum plate. 3. Wash out plate. 4. Put plate on cylinder (packer, if required). 5. Get the lay.	Plate No. 1 (black). All needed material to be on hand. Two-color label job. Paper M. F. Black ink to be mixed by instructor. Press O. K. for running.	Unit I. P. 11.
B		
1. Mix black ink. 2. Pull impression. 3. Make adjustments, if necessary. 4. Put side-guide mark on plate. 5. Run the job.	Black ink. Press O. K. for running.	

IV. Purpose: (1) To teach how to mark cylinder and take side mark for multi-colored jobs. (2) To teach how to prepare plates for storage.

Content	*Required Preparation*	*References*
1. Mark cylinder and take side mark.	Plate No. 2 (light blue).	Unit I. P. 100.
2. Take plate No. 1 off and prepare for storage.		
3. Clean cylinder and bearers.	Sheet printed during previous session to be loaded into feeder.	
4. Clean back of plate No. 2.		
5. Re-gum plate.		
6. Mark plate.		
7. Put plate on cylinder, as per marks.	No printing to be done in this session.	

V. Purpose: (1) To teach how to mix light blue color. (2) To make clear why black was printed first. (3) To provide practice.

Content	*Required Preparation*	*References*
1. Mix color.	Laketine, Milori or Chinese blue ink.	
2. Pull impression for register.	Varnish has to be provided, everything else O. K.	
3. Make necessary adjustments.	Instructor is to O. K. color.	
4. Pull impression for proper shade and consistency.		
5. Make necessary adjustment.		
6. Cover register difficulties, if any.		
7. Pull quality impression.		
8. Run job.		

VI–VII. Purpose: (1) To teach how to mix opaque orange color, and why it is printed ahead of the black. (2) To provide practice.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 3 (orange). Two-color label job.	Unit I. P. 16
2. Clean back of plate.		
3. Re-gum plate.		
4. Mark plate.	Coated stock.	
5. Put plate on (packer, if required).	Opaque orange ink.	
6. Get the lay.	Instructor to mix and to O. K. color.	
7. Mix color.		
8. Correct lay, if necessary.		
9. Put side-guide mark on plate.		
10. Pull quality impression.		

Content	*Required Preparation*	*References*
11. Run job.		
12. Put mark on cylinder and take side mark.		
13. Take plate off and prepare for storage.		

VIII–IX. Purpose: (1) To teach how to mix black ink for this type of job and paper. (2) To provide practice.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 4 (black).	
2. Clean back of plate.		
3. Re-gum plate	Orange printed sheets piled into feeder.	
4. Mark plate.		
5. Wash out plate.		
6. Put plate on cylinder as per marks.		
7. Mix color.		

X–XI–XII. Purpose: (1) To test ability to mark plate and to put it on cylinder (packing, if required). (2) To mix black ink for label job. (3) To mark cylinder and take side-guide mark. (4) To mix light blue color. (5) To prepare plate for storage.

XIII. Purpose: (1) To provide information regarding the manufacturing and origin of different colors.
Special lecture on offset inks. Visit a manufacturing plant or see exhibition of colors in various stages of manufacturing.

XIV–XV. Purpose: (1) To teach how to mix yellow and to print type job.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 5 (yellow).	Unit II. P. 19.
2. Clean back of plate (No. 5).	Four-color half-tone job.	
3. Re-gum plate.	Medium offset stock.	
4. Mark plate.	Yellow ink.	
5. Wash out plate.	Press O. K.	
6. Put plate on.		
7. Mix color.		
8. Get lay.		
9. Make side-guide mark.		
10. Try for register.		
11. Compare with proof.		
12. Rub down heavy work, if necessary.		
13. Pull quality impression.		
14. Make run.		
15. Mark cylinder.		
16. Take side mark.		
17. Take plate off.		

XVI–XVII. Purpose: To teach how to mix black ink (second color) and print type job.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 6 (black).	
2. Clean back of plate (No. 6).	Four-color half-tone job.	
3. Re-gum plate.	Yellow printed sheets to	
4. Mark plate.	be loaded into the feeder.	
5. Wash out plate.	Black ink.	
6. Put plate on.		
7. Mix color.		
8. Get register.		
9. Make side-guide mark.		
10. Try for register.		
11. Compare with proof.		
12. Rub down heavy work, if necessary.		
13. Pull quality impression.		
14. Make run.		
15. Take plate off.		

XVIII–XIX. Purpose: (1) To teach how to mix red ink (third color) and print type job.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 7 (red).	
2. Clean back of plate (No. 7).	Four-color half-tone.	
3. Re-gum plate.	Red ink according to needs	
4. Mark plate.	of the job.	
5. Wash out plate.	Same sheets to be loaded	
6. Put plate on.	into the feeder.	
7. Mix color.		
8. Pull impression.		
9. Mix color.	If printed sheets are too	
10. Get register.	long, increase printing cyl-	
11. Compare with proof.	inder diameter.	
12. Rub down, if necessary.	Adjust pulleys and suckers	
13. Pull quality impressions.	to miss work on sheets.	
14. Make run.		
15. Take plate off.		

XX–XXI. Purpose: (1) To teach how to mix blue ink (fourth color) and print type job.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 8 (blue).	
2. Clean back of plate (No. 8).	Four-color half-tone.	
3. Re-gum plate.	Laketine and blue ink ac-	
4. Mark plate.	cording to the proof.	
5. Wash out plate.	Same sheets to be loaded	
6. Put plate on.	into the feeder.	
7. Mix color.		
8. Get register.		
9. Compare with proof.		

Content	*Required Preparation*	*References*
10. Rub down, if necessary.		
11. Pull quality impression.		
12. Make run.		
13. Take plate off.		

XXII. Oral quiz covering:

a. Color mixing
b. Register troubles
c. Detecting and overcoming difficulties already met
d. Comparing impression with proof.

XXIII. Purpose: (1) To teach how to set impression cylinder grippers.

Content	*Required Preparation*	*References*
1. (Content depends somewhat upon make of press.)		
2. Turn press to proper position. Loosen, adjust, and set grippers. Run trial sheets.	None.	Unit I. P. 32.

XXIV. Purpose: (1) To teach how to set delivery grippers.

Content	*Required Preparation*	*References*
1. Loosen, adjust, and set grippers. Run trial sheets.	None.	Unit I. P. 34.

XXV. Purpose: (1) To provide information regarding the manufacture of different kinds of paper.
Special illustrated lecture on paper. Exhibition of various materials used in paper making ..... Unit VI

XXVI. Purpose: (1) To test student information. (2) To clear up any misunderstandings. Oral quiz covering points mentioned at last session on paper making.

XXVII–XXVIII. Purpose: (1) To teach how to mix yellow and to print first color type job. (2) To make clear the meaning, cause, and remedy for *dry* plates.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 9 (yellow).	Unit II. P. 44
2. Clean back of plate.	Six-color half-tone with	
3. Re-gum plate.	solids.	
4. Mark plate.		
5. Wash out plate.		
6. Put plate on.		
7. Mix color.		
8. Get lay.	See that plate becomes	
9. Make side-guide mark.	"dry" and takes ink.	
10. Try for register.		
11. Correct trouble.		
12. Compare with proof.		

Content	*Required Preparation*	*References*
13. Pull quality impression.		
14. Make run.		
15. Mark cylinder and take side mark.		
16. Take plate off.		

XXIX–XXX. Purpose: (1) To teach how to mix black for second color print-type job. (2) To explain conditions under which paper *picks*, and, (3) To indicate possible cause or causes and remedies for same.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 10 (black) six-color job.	
2. Clean back of plate.		
3. Re-gum plate.	Yellow printed sheets loaded into feeder.	
4. Mark plate.		
5. Wash out plate.		
6. Put plate on.		
7. Mix color.	See that ink is too stiff for paper as a result of which the paper "picks."	Unit II. P. 50
8. Get register.		
9. Make side-guide mark.		
10. Try register.		
11. Correct trouble, compare with proof.		
12. Pull quality impression.		
13. Make run.		
14. Take plate off.		

XXXI–XXXII. Purpose: (1) To teach how to mix red and print third color on job. (2) To make clear the meaning of oxidation as applied to metal plates. (3) To demonstrate a weak design and to point out its possible causes and remedies.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate II (red).	
2. Clean back of plate.	Six-color job—same sheets loaded into feeder.	
3. Re-gum plate.		
4. Mark plate.	See that portion of design is weak.	Unit II. P. 42.
5. Wash out plate.		
6. Put plate on.	See that plate is exposed so that it oxidizes.	
7. Mix color.		
8. Pull impression.		
9. Correct trouble.		
10. Mix color.		
11. Get register.		
12. Compare with proof.		
13. Correct trouble.		
14. Pull quality impression.		
15. Adjust pulleys and suckers.		
16. Make run.		
17. Take plate off.		

XXXIII–XXXIV. Purpose: (1) To teach how to mix blue and print fourth color on type job. (2) To demonstrate effect upon impression of too much water. (3) To demonstrate results of uneven distribution of ink. (4) To show effect that foreign substance on blanket has on impression.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 12 (blue).	
2. Clean back of plate.	Six-color job. Same sheets as before.	Unit II. P. 22.
3. Re-gum plate.		
4. Mark plate.	See that too much water reaches the plate long enough to weaken the impression.	
5. Wash out plate.		
6. Put plate on.		
7. Mix color.		
8. Pull impression.		
9. Correct trouble.		
10. Get register.		
11. Correct trouble.	See that flow of ink is uneven enough to produce streaks.	Unit II. Pp. 43, 45.
12. Pull impression and correct trouble.		
13. Pull quality impression.	See that impression is defective because of foreign substance on blanket.	
14. Compare with proof.		
15. Make run.		
16. Take plate off.		

XXXV–XXXVI. Purpose: (1) To teach how to mix pink and print fifth color on type job. (2) To show nature of impression which is too sharp, make clear the cause, and correct conditions.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 13 (pink).	
2. Clean back of plate.	Six-color job. Sheets same as before.	
3. Re-gum plate.		
4. Mark plate.		
5. Wash out plate.	See that plate prints too sharp.	Unit II. P. 27.
6. Put plate on.		
7. Mix color.		
8. Pull impression.		
9. Get register.		
10. Compare with proof.		
11. Correct trouble.		
12. Pull quality impression.		
13. Make run.		
14. Take plate off.		

XXXVII–XXXVIII. Purpose: (1) To teach how to mix gray and print sixth color on type job. (2) To teach how to change shade of color. (3) To make clear the meaning of term, "impression is too full," the causes of same, and the remedy therefor.

Content	*Required Preparation*	*References*
1. Clean cylinder and bearers.	Plate No. 14 (gray).	
2. Clean back of plate.	Six-color job.	
3. Re-gum plate.	Sheets same as before.	Unit II. Pp.
4. Mark plate.		18, 19.
5. Wash out plate.		
6. Put plate on.	See that shade of color	
7. Mix color.	is not O. K.	
8. Pull impression.		
9. Correct shade of color.	See that plate prints too	
10. Pull impression.	full.	Unit II. P. 32.
11. Get register.		
12. Correct strength of impression.		
13. Pull quality impression.		
14. Compare with proof.		
15. Make run.		
16. Take plate off.		

XXXIX, XL, XLI. Purpose: (1) To test student's ability to mix colors and to overcome all types of difficulties already covered. Test to last three sessions or more.

XLII. Purpose: (1) To acquaint the students with the various kinds of work done in lithographing plants.
Exhibition of lithographic product.
Samples of work done on all kinds of paper, tin, machine, decalcomania, ceramic, etc.

XLIII. Purpose: (1) To check upon the student's knowledge, by the "true-false" test method.

B. Preparing Instructional Material

The analysis in Chapter III constituted the chief source of the basic text material[7]. To a slight extent only was it necessary to modify this content when preparing the texts. In one important respect the same technique was followed when preparing the basic text material as when making the analysis, in that statements were set up and submitted to expert tradesmen for acceptance or rejection. In fact, not a line of the basic text material was published until approved by ten or more experts. The suggested corrections, if any, received from coöperating tradesmen, were invariably considered in conference with one or more experts, at which conference apparent or real differences in expressed points

[7] The seven units comprising Group I of *Basic Texts for Apprentices in Lithography* (Published by Lithographic Technical Foudation, Inc. 160 East 56th St. New York City) have the following titles: 1. Operating the Press; 2. Detecting and Overcoming Difficulties; 3. Offset Inks; 4. Offset Blankets; 5. Offset Plates; 6. Offset Papers; 7. Offset Rollers. Bound copies of these texts are on file in the Columbia University library.

of view were ironed out. In case agreement could not be reached on any point, it was excluded from the body of the text and made a footnote.

Especial attention is called to the numerous illustrations scattered throughout Unit 2 of the Basic Texts, all of which are lithographed so as to show clearly the nature of the trouble. It should be understood that the remaining defects could be similarly illustrated. As yet no attempt has been made to test the principles involved in the construction of this unit. There is little doubt, however, but that they will prove equal to the demands.

CHAPTER VIII

SUMMARY AND CONCLUSIONS TO PART II

As indicated in Chapter I, the reasons for making the analysis in this instance were (*a*) that a course of study might be set up, and (*b*) that basic texts for apprentices might be prepared. With the analysis available, the task therefore became one of using the analysis for the purposes specified. This proved to be largely a constructing or synthesizing experience; a reorganization and interpretation of the newly acquired information so as to meet the conceived needs of offset pressmen apprentices. Briefly, the principles observed when setting up the course of study and when preparing the instructional matter were: (1) They must represent trade practice. (2) They must meet the needs of apprentices. (3) They must omit controversial points in so far as these can be detected.

Before attempting to set up the course of study, the following questions were tentatively answered: (1) What are or should be the objectives of this course in the way of apprentice acquisitions? (2) What must the content be in order that these objectives may be realized? (3) What should the sequential arrangement be in order that the desired objectives may be attained? (4) To what extent and in what way should the matter of emphasis (amount of time) given to various parts or phases of the content affect the "set up"?

It was assumed that the analysis in Chapter III would constitute a satisfactory source of material for the course of study. It was further assumed that proper sequential arrangement of the content might be determined, although not necessarily conclusively, by any one of seven possible ways or by a combination of two or more of these ways. Finally, it was assumed that the question of the degree of emphasis that should be given to different parts of the trade content would necessarily have to be left largely undetermined for reasons mentioned in a later paragraph.

To the end that an approximate learning-difficulty order might

be determined for the various operations constituting the trade, appropriate forms were prepared and used for securing the respective judgments of expert tradesmen regarding the relative difficulness of the various operations. The composite of the judgments of six such experts corresponded so closely with the judgment of the investigator, independently reached, that it was deemed inadvisable to carry the experiment further. An important factor contributing to the decision not to proceed further with this phase of the work was the belief on the part of the investigator, which belief was concurred in by the pressmen, that only a few of the trade operations are really difficult to learn. In other words, the question of relative difficultness of the various operations, with the possible exception of a half dozen or so, was found to be of secondary rather than primary importance when setting up the course of study. First place, it was concluded, could be and therefore should be given to the matter of natural or production sequence; consequently, this was done. The other factors considered when setting up the course were chiefly of a pedagogical nature.

A significant feature of the technique employed for determining the relative difficultness of the various trade operations consisted in analyzing each operation into its component parts, i.e., specific trade facts, skills, and judgments, and the further analysis of these specific skills and judgments to discover the minutest details of each. Whether or not this laborious procedure and the information gained thereby influenced the investigator, when passing judgment upon the relative difficultness of the various trade operations, is impossible to say. It is believed, however, that such was the case.

The suggested course of study is the outcome of many conferences between the investigator and an expert offset pressman who was enrolled in his Trade Analysis Class at Hunter College during the year 1926–1927. It represents the work of weeks rather than of days or hours, and has been checked and rechecked many times. While the needs of apprentices who are employed daily in lithographing plants and who attend school approximately two and a half hours on each of two nights per week were kept constantly in mind, it was not assumed at any time that the designated content of the respective units would necessarily correspond exactly with the successive evenings of class work. It was realized, in

other words, that the suggested course of study must pass through the acid test of experience under ordinary conditions and be revised in accordance with the findings.

That phase of the study which pertains to basic text material may be quickly summarized. Here also the governing purpose was to provide vital information regarding the trade, and to provide it in a form that would be most helpful to apprentices. Necessarily the source book, so to speak, for this material was the trade analysis. To a slight degree only was it necessary to supplement this.

The instructional material shows rather clearly, it is believed, that answers to the following questions were attempted in each instance: (1) What is the particular defect in mind? (2) To what cause or causes may it be due? (3) How, if at all, may it be prevented or overcome? (4) What precautionary measures, if any, are necessary?

The experiences of the writer warrant the following conclusions which it is believed may prove of worth to others:

1. It is clearly possible for one to discover through observation and analysis the approximate learning-difficulty order of the operations constituting a trade without having practiced that trade.

2. The question of learning-difficulty order is of minor importance, relatively speaking, in some trades, that of production sequence being of much greater importance.

3. Tradesmen without teaching experience cannot be expected to detect and analyze the problems connected with the construction of a course of study.

4. Tradesmen may prove invaluable allies, in the preparation of courses of study, by reason of their familiarity with the details of trade practice and their consequent ability therefore to serve as practical checks to an "outsider."

5. An "outsider" can analyze a trade and prepare basic texts which not only meet the approval of, but are eagerly sought by, those for whom they were prepared.

6. The preparation of basic text material requires very close coöperation (*a*) with those who work at the trade, and (*b*) with the manufacturers of materials and equipment used by the trade.

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